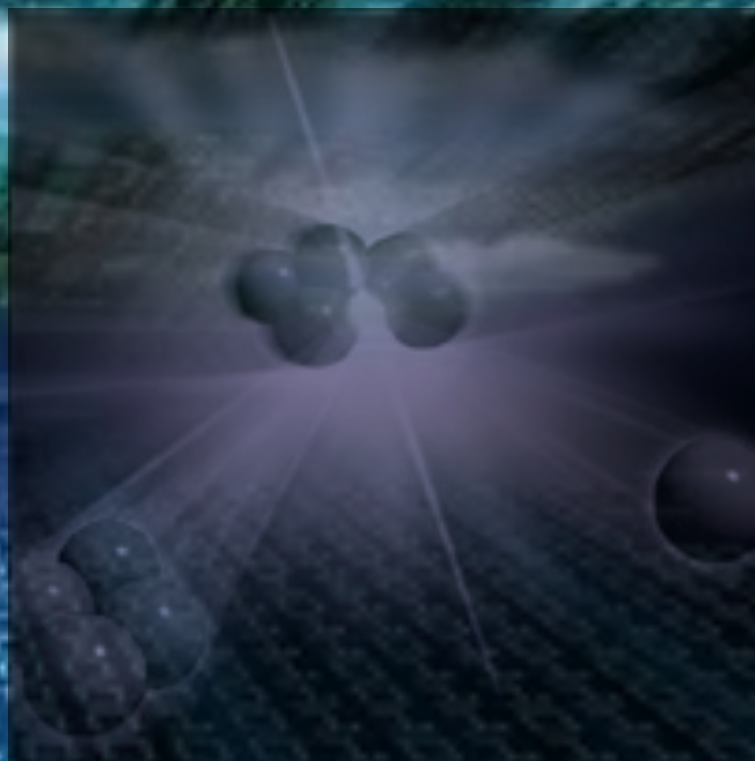


Cloud Computing for Nuclear Data



MICHAEL SMITH
PHYSICS DIVISION
OAK RIDGE NATIONAL LAB

summary

- IF
 - WE **REALLY WANT** THE BASIC & APPLIED NUCLEAR SCIENCE COMMUNITIES TO USE OUR CODES AND OUR DATA

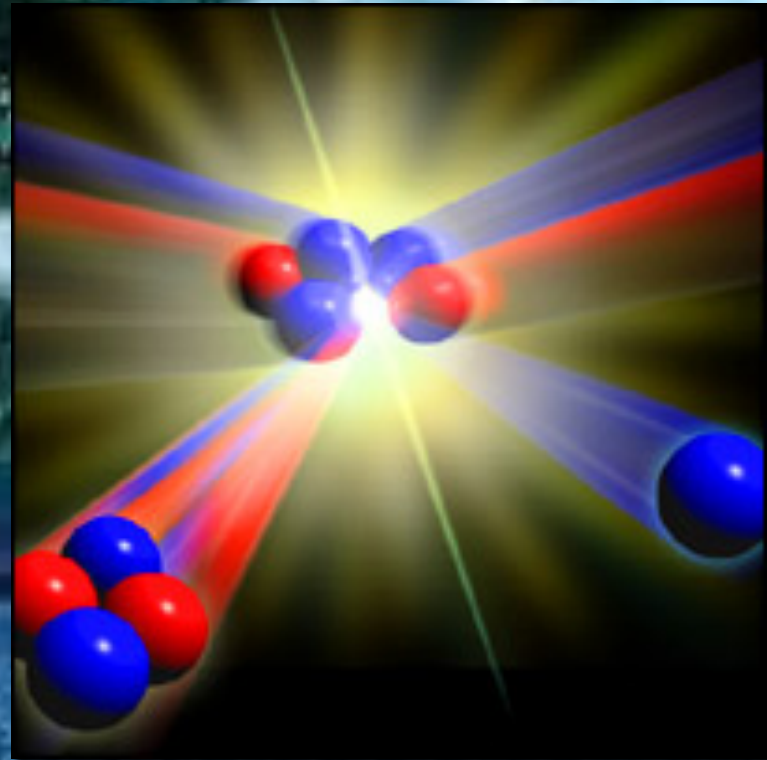
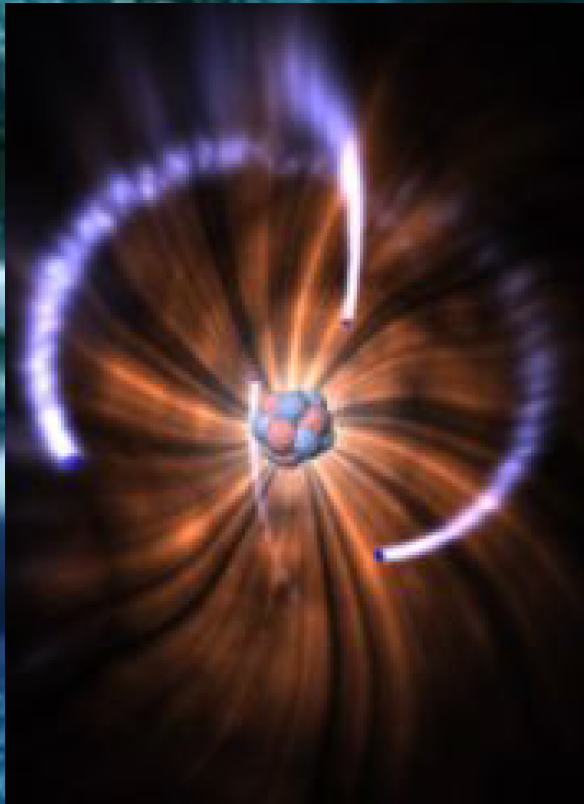
summary

- IF
 - WE **REALLY WANT** THE BASIC & APPLIED NUCLEAR SCIENCE COMMUNITIES TO USE OUR CODES AND OUR DATA
- THEN
 - WE SHOULD DO EVERYTHING WE CAN TO MAKE IT **EASY** FOR THEM
 - RUN CODES ONLINE - NO NEED TO DOWNLOAD
 - MULTIPLE DATA FORMATS THAT **THEY** LIKE
 - ONLINE HELP, PIPELINES/GUIDES, LIVE SUPPORT
 - DISSEMINATION FROM MULTIPLE SOURCES
 - PROACTIVE EFFORTS TO HELP USERS ...

summary

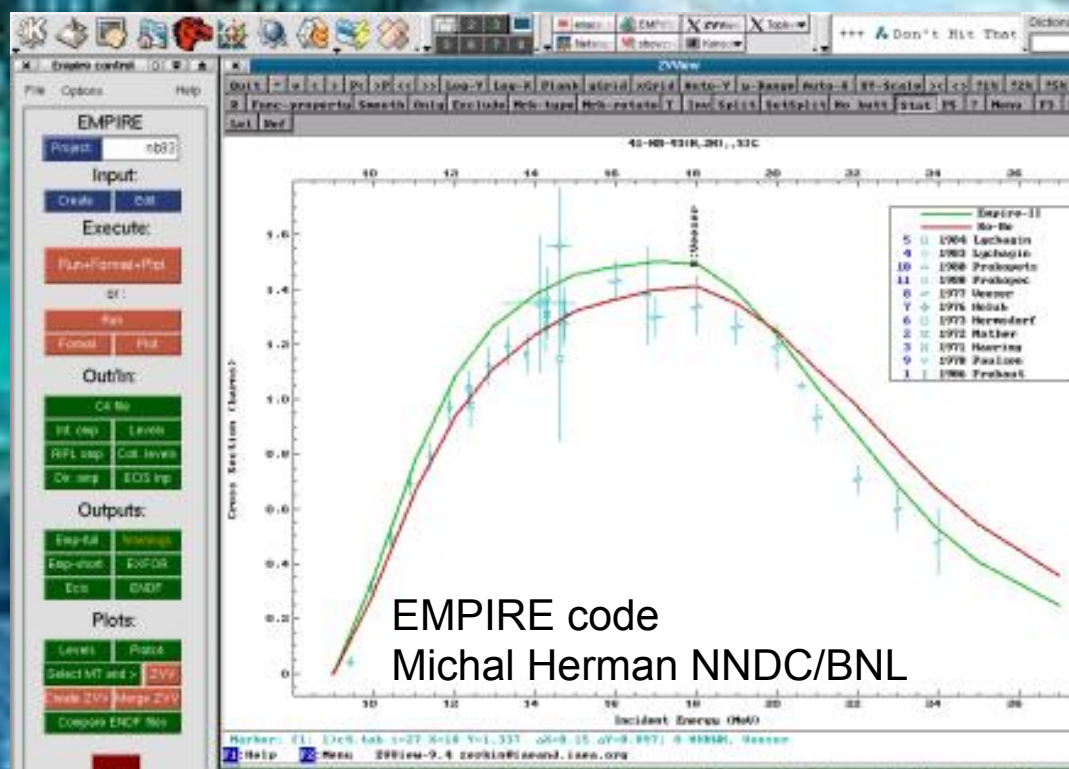
- IF
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 - RUN CODES ONLINE - NO NEED TO DOWNLOAD
 - MULTIPLE DATA FORMATS THAT **THEY** LIKE
 - ONLINE HELP, PIPELINES/GUIDES, LIVE SUPPORT
 - DISSEMINATION FROM MULTIPLE SOURCES
 - PROACTIVE EFFORTS TO HELP USERS ...
- THIS CHANGE WILL ALSO HELP US DEAL WITH THE CRUSH OF NEW DATA

nuclear information



- STUDIES IN BASIC & APPLIED NUCLEAR SCIENCE REQUIRE BEST INFORMATION ON
 - STRUCTURE OF NUCLEI
 - REACTIONS BETWEEN NUCLEI

data generation and data processing



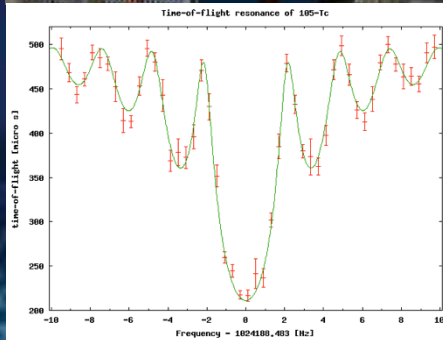
- IMPROVEMENTS REQUIRE EFFORTS IN **BOTH**
 - DATA GENERATION (MEASUREMENTS, THEORY)
 - DATA COMPILATIONS / EVALUATIONS / PROCESSING

data generation and data processing

HFB14 masses

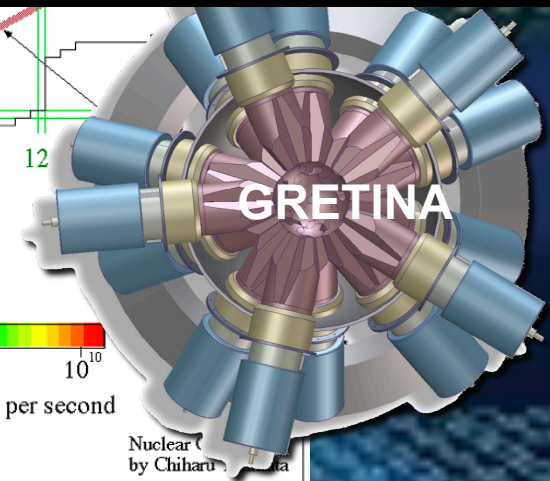
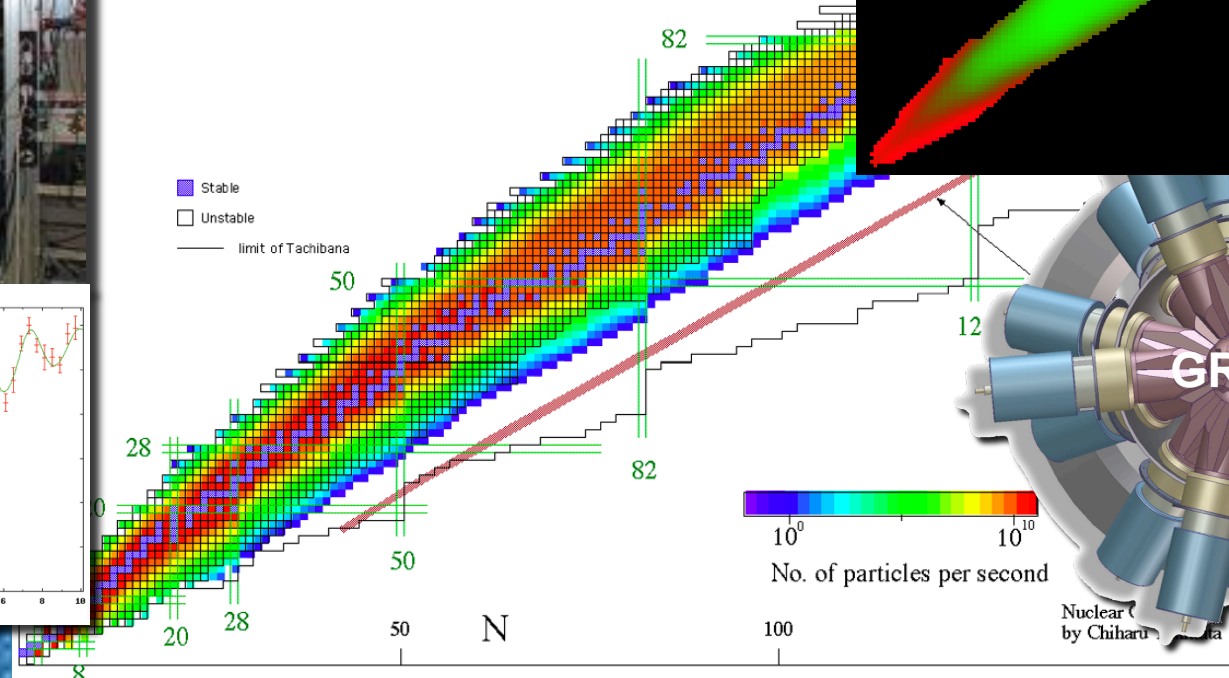


JYFLTRAP



RI Beam Intensity at the RI Beams Factory

Primary beam of 1 pμA is assumed.
Calculated by Intensity II
By Nakamura



Nuclear
by Chiharu

- DATA GENERATION **RACING AHEAD**, DRIVEN BY
 - LARGE DETECTOR ARRAYS
 - TRAPS FOR HIGH PRECISION MASS MEASUREMENTS
 - INTENSE BEAMS OF UNSTABLE NUCLEI [FRIB !]
 - SOPHISTICATED NUCLEAR MODELING CODES

cloud computing for nuclear data

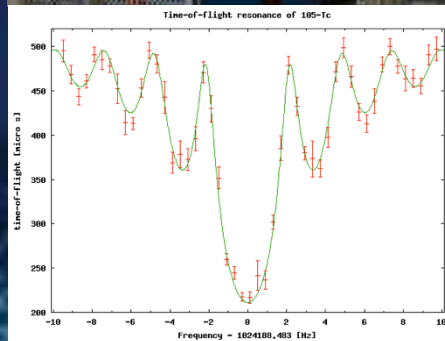
michael smith ornl

data generation and data processing

HFB14 masses

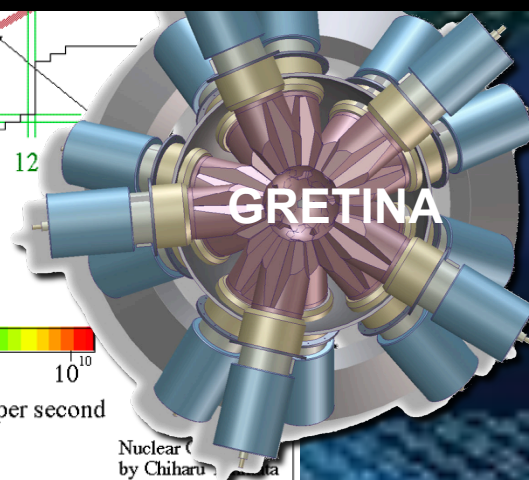
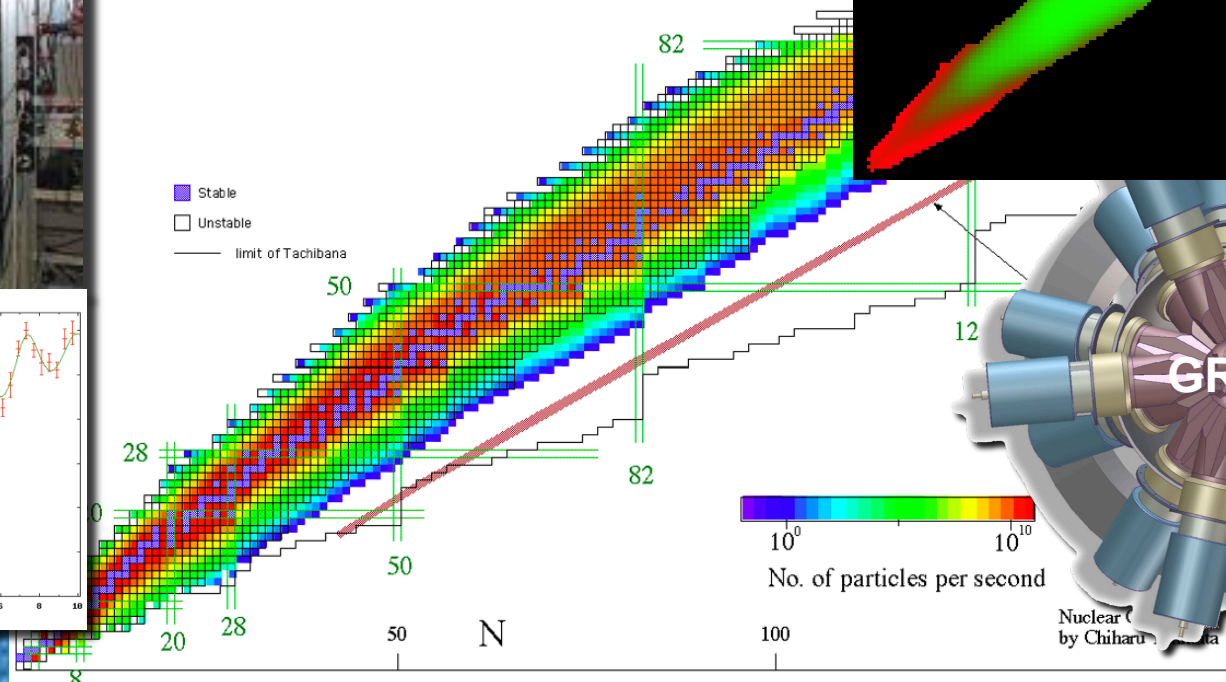


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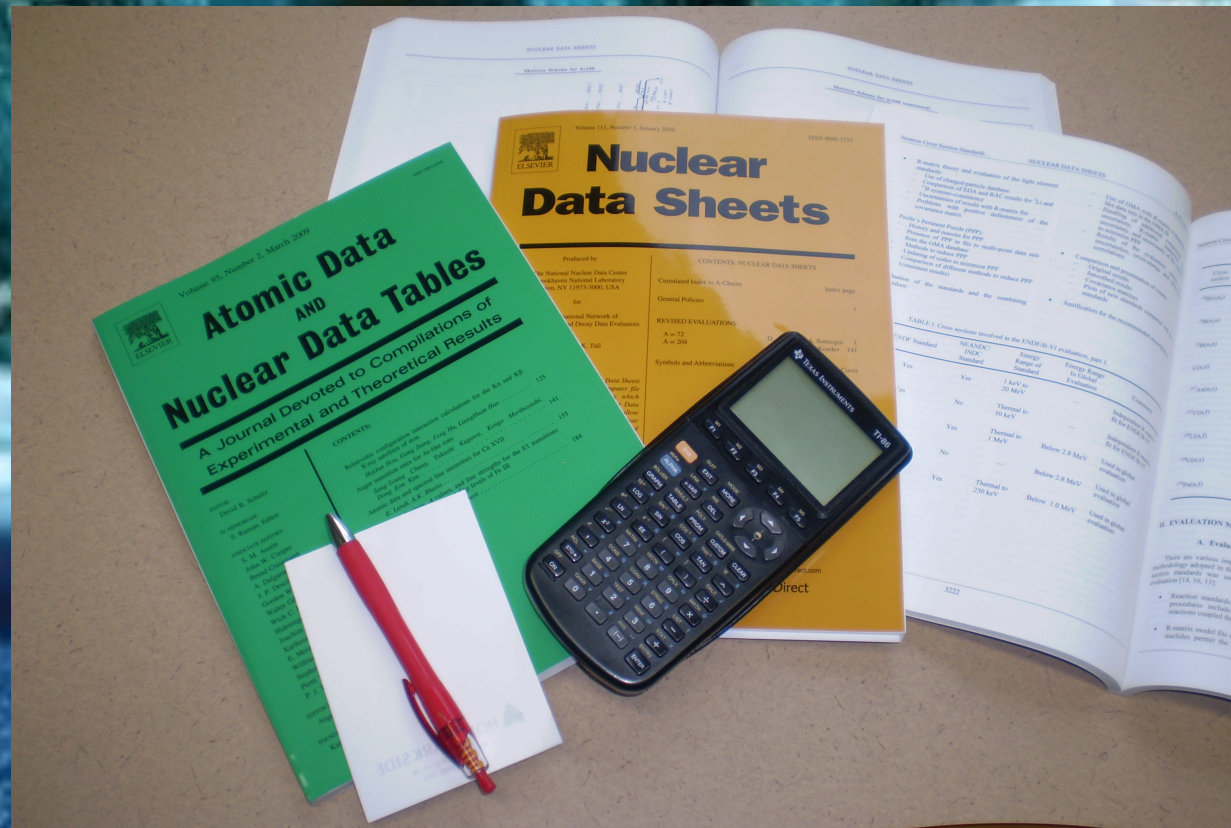
Nuclear
by Chiharu

- DATA PROCESSING IS **LAGGING BEHIND** ...
 - MASSES NOT FULLY UPDATED SINCE 2003 [AME2003]
 - MANY BETA DECAYS NOT YET IN ENSDF
 - CHARGED-PARTICLE INDUCED REACTIONS ON UNSTABLE NUCLEI NEED EVALUATIONS

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data generation and data processing

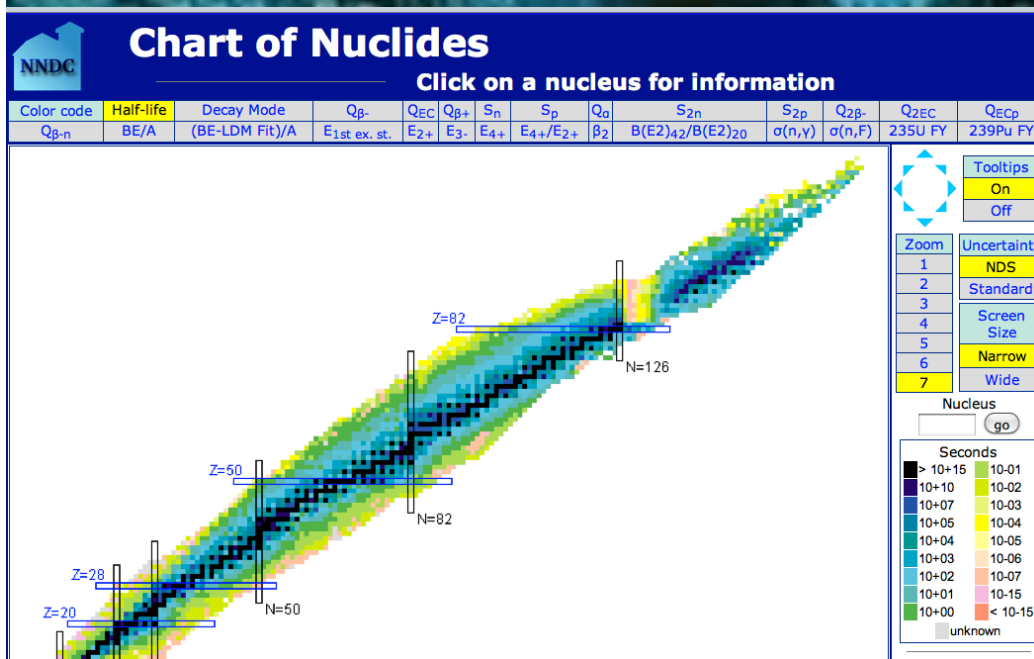


- WHY IS DATA PROCESSING LAGGING BEHIND ?
 - SHRINKING EVALUATION MANPOWER
 - MORE AND MORE DATA !
 - MORE COMPLEX DATA SETS
 - FEW CHANGES IN METHODOLOGY

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evaluation methodologies in nuclear science



Search Page - The JINA React...

groups.nsl.msu.edu/jina/reactlib/db/search.php

The Joint Institute for Nuclear Astrophysics

REACLIB Database

you are not logged in! [login] [sign up]

Search Rates

Here you can search the REACLIB database for reaction rates. Refine your search with the criteria displayed below. For a more detailed description, see the [help page](#).

Limit Search

Library: [dropdown]
Reaction Type: [dropdown]
Label: [dropdown]
Results per page: 50

Additional Criteria

☒ Theoretical
☒ Experimental
☐ Show All Versions of Rate
☐ Exclude Weak Rates
☐ Only Weak Rates
☐ Exclude Reverse Rates
☐ Only Future Rates

- THERE HAVE BEEN METHODOLOGY ADVANCES ...
 - ONLINE DATABASES
 - NICE DATA VIEWERS
 - SOME ONLINE CODES
 - GOOGLE SEARCHES ...

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evaluation methodologies in nuclear science

Woods Saxon Calculator

Generate Parameters¹ N= , Z= , check for proton ☐

Reduced mass [MeV]

Central Potential

Radius [fm]

Diffuseness [fm]

Depth [MeV]

Spin Orbit Potential

Radius [fm]

Diffuseness [fm]

Depth [MeV fm²]

Coulomb Potential

Radius [fm]

Diffuseness [fm]^{*}

Charge (mean field) [integer]

www.volya.net/

Q-value Calculator (QCalc)

www.nndc.bnl.gov/qcalc/

National Nuclear Data Center

Search the NNDC:

QCalc calculates Q-values for nuclear reactions or decays. It uses mass values from the 2003 Atomic Mass Evaluation by Audi et al.

Target(s)
56fe, Fe56, 26056, cr50-fe56
use dash for range only

Projectile **E_{lab} (MeV)**
4He, He-4, 2-he-4, a, alpha, 2004

Ejectile
g, n, n+p, 2n+a, 2a+12c (reaction)
b-, ec, 2b-, b-n, ecp, 18O (decay)

Uncertainties
☒ Standard style
☐ Nuclear Data Sheets style

Input requirements, more in [Help](#):

Google

www.google.com

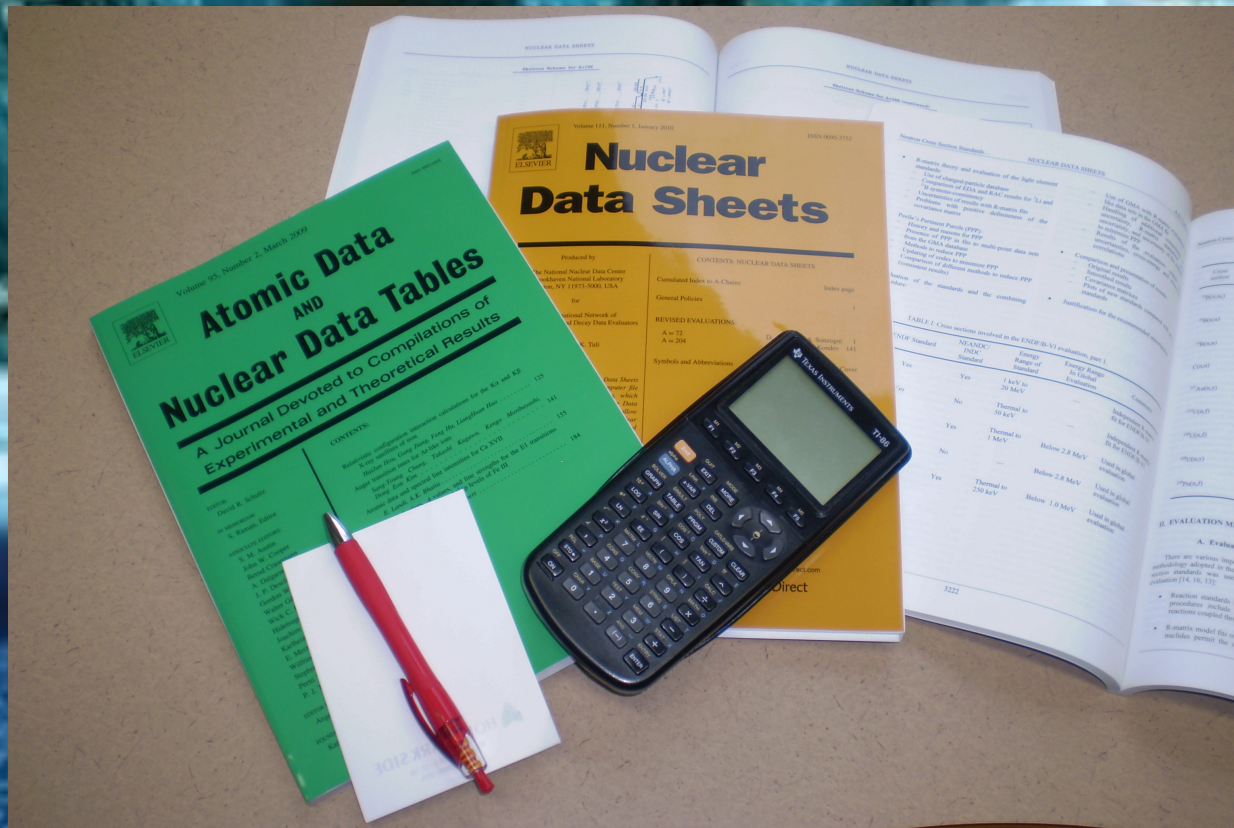
Google

- THERE HAVE BEEN METHODOLOGIES
 - ONLINE DATABASES
 - NICE DATA VIEWERS
 - SOME ONLINE CODES
 - GOOGLE SEARCHES ...

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evaluation methodologies in nuclear science



- METHODOLOGY **BREAKTHROUGHS** ARE **POSSIBLE** - & **NECESSARY** TO KEEP UP WITH ALL THE NEW DATA !

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new online paradigm

IMAGINE ...

HAVING A DIGITAL ASSISTANT WHO
AUTOMATICALLY COLLECTS RELEVANT MASSES,
LEVEL SCHEMES, REFERENCES ...

A WAY FOR EXPERTS TO EASILY UPLOAD
SUPPLEMENTAL INFORMATION FOR YOUR
EVALUATIONS

HAVING ALL MAJOR DATABASES JUST ONE MOUSE
CLICK AWAY

HAVING AN EVALUATION TEMPLATE AUTOMATICALLY
FILLED OUT FOR YOU

RUNNING ANALYSIS & APPLICATION CODES WITHOUT
COMPATIBILITY, UPDATES, BACKUPS, OR CYBER
SECURITY ISSUES

new online paradigm

IMAGINE ...

DESIGNING CUSTOM VIEWS OF DATASETS FROM A VARIETY OF VISUALIZATION TOOLS

HAVING A "VIRTUAL EXPERT" ONLINE 24/7 TO CONSULT WITH QUESTIONS

SHARING YOUR LARGE DATA SETS EASILY WITH COLLEAGUES

EASILY UPLOADING YOUR EVALUATION AND VISUALLY TRACKING ITS PROGRESS FOR REVIEWS, REVISIONS, & ACCEPTANCE

USING A PIPELINE TO PROCESS YOUR EVALUATED DATA FOR USE IN SIMULATIONS CODES

RUNNING & VISUALIZING THESE SIMULATIONS, THEN SHARING THE RESULTS WITH COLLEAGUES

[illegible]

NOW IMAGINE ALL OF THESE SERVICES ARE **FREE**
SUPPLEMENTS TO YOUR RESEARCH
YOU CAN PICK AND CHOOSE WHICH ONES TO USE

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YOU CAN PICK AND CHOOSE WHICH ONES TO USE

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new online paradigm



- THIS **NEW ONLINE WAY TO WORK** NOT A WILD DREAM ... SOME COMPONENTS ARE **ALREADY ONLINE** !

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new online paradigm



- WORKING ONLINE STREAMLINES REPETITIVE TASKS, GREAT FOR NOVICES OR EXPERTS, **ATTRACTS STUDENTS** ...

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cloud computing



- CLOUD COMPUTING: LATEST TREND IN SOFTWARE (GOOGLE APPS ...)
- RUN ON REMOTE SERVERS "IN THE CLOUDS"
- LET SOMEONE ELSE WORRY ABOUT MAINTENANCE, UPDATES, BACKUPS, SECURITY COSTS

cloud computing



- **ADVANTAGES: NO ISSUES WITH PLATFORM COMPATIBILITY, COMPILATION ERRORS, INSTALLATION HASSLES TYPICAL OF CODE DOWNLOAD SERVICES**

examples of first generation tools

- SOME FIRST GENERATION TOOLS BUILT & DEPLOYED
 - WORKFLOW MANAGEMENT
 - VIRTUAL PIPELINES
 - ONLINE END-USER APPLICATIONS
 - DATABASE ACCESS
 - FILE REPOSITORY
 - DATA VISUALIZATION
 - INFORMATION SHARING
 - DATA HARVESTING

workflow management



- MANY STEPS FROM STARTING AN EVALUATION TO HAVING IT PUBLISHED
- WOULD BE GREAT TO GIVE **TRANSPARENCY & CLARITY** TO THIS WORKFLOW

workflow management

The screenshot shows a web application window titled "Browse Status". The main header area contains "Browse Status | Status Viewer" on the left and "Step 2 of 2" on the right. On the left side, there is a vertical flowchart with six steps: "Evaluation Folder Open" (highlighted with a red border), "Under Evaluation", "Evaluation Submitted", "Under Referee Review", "Referee Report Submitted", and "Editorial Approval". To the right of the flowchart, the text "Selected Reaction : 4He + 15N --> 19F" is displayed. Below this, instructions state: "Click on any of the available states of this evaluation folder from the flowchart at the left to access information." Further down, it shows "Evaluation Folder Creation Date : 11/17/07 10:20 AM" and "Number of Files : 4". A note says: "Below is a list of files in this evaluation folder. To view a file, highlight it and click *View Selected File*." Below the note is a table with three columns: "Filename", "Creation Date", and "Modification Date". The table lists four files: "image.JPG", "text.txt", "presentation.ppt", and "document.doc". At the bottom of the window, there are three buttons: "< Back", "Close Browse Status", and "Browse Status Home".

Browse Status

Browse Status | Status Viewer Step 2 of 2

Evaluation Folder Open

Under Evaluation

Evaluation Submitted

Under Referee Review

Referee Report Submitted

Editorial Approval

Selected Reaction : 4He + 15N --> 19F

Click on any of the available states of this evaluation folder from the flowchart at the left to access information.

Evaluation Folder Creation Date : 11/17/07 10:20 AM

Number of Files : 4

Below is a list of files in this evaluation folder.
To view a file, highlight it and click *View Selected File*.

Filename	Creation Date	Modification Date
image.JPG	11/17/07 10:27 AM	11/17/07 10:28 AM
text.txt	11/17/07 10:26 AM	11/17/07 10:28 AM
presentation.ppt	11/17/07 10:25 AM	11/17/07 10:28 AM
document.doc	11/17/07 10:25 AM	11/17/07 10:28 AM

View Selected File

< Back Close Browse Status Browse Status Home

- WE BUILT **WORKFLOW TOOLS** FOR AN INTERNATIONAL COLLABORATION IN NUCLEAR ASTROPHYSICS

workflow management

The screenshot shows a web application window titled "Browse Status". The main header area contains "Browse Status | Status Viewer" on the left and "Step 2 of 2" on the right. On the left side, there is a vertical flowchart with six steps: "Evaluation Folder Open" (highlighted with a red border), "Under Evaluation", "Evaluation Submitted", "Under Referee Review", "Referee Report Submitted", and "Editorial Approval". To the right of the flowchart, the text "Selected Reaction : 4He + 15N --> 19F" is displayed. Below this, instructions state: "Click on any of the available states of this evaluation folder from the flowchart at the left to access information." Further down, it shows "Evaluation Folder Creation Date : 11/17/07 10:20 AM" and "Number of Files : 4". A message follows: "Below is a list of files in this evaluation folder. To view a file, highlight it and click *View Selected File*." Below this message is a table with three columns: "Filename", "Creation Date", and "Modification Date". The table lists four files: "image.JPG", "text.txt", "presentation.ppt", and "document.doc", all with creation dates around 11/17/07 10:25 AM and modification dates around 11/17/07 10:28 AM. A "View Selected File" button is located below the table. At the bottom of the window, there are three buttons: "< Back", "Close Browse Status", and "Browse Status Home".

Browse Status

Browse Status | Status Viewer Step 2 of 2

Evaluation Folder Open

Under Evaluation

Evaluation Submitted

Under Referee Review

Referee Report Submitted

Editorial Approval

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presentation.ppt	11/17/07 10:25 AM	11/17/07 10:28 AM
document.doc	11/17/07 10:25 AM	11/17/07 10:28 AM

View Selected File

[< Back](#) [Close Browse Status](#) [Browse Status Home](#)

- EASILY **UPLOAD** YOUR EVALUATION & **VISUALLY TRACK** ITS PROGRESS FOR REVIEWS, REVISIONS, & ACCEPTANCE

workflow management



- **AUTOMATES** & **ARCHIVES** DIFFERENT TASKS FOR EVALUATORS, REFEREES, EDITORS ...
- SYSTEM IS **CUSTOMIZABLE** FOR DIFFERENT FIELDS

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workflow management

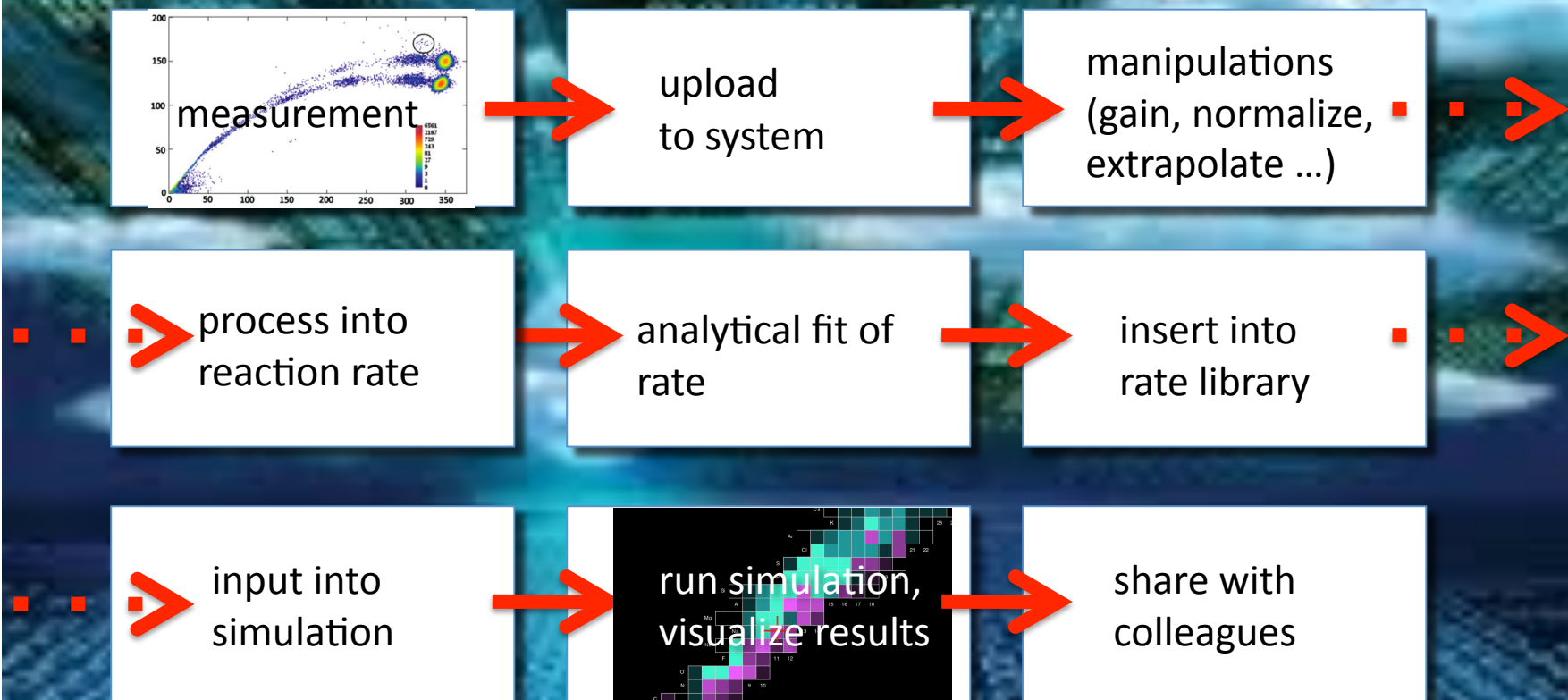


- WOULD WORK GREAT FOR **ENSDF EVALUATIONS**

cloud computing for nuclear data

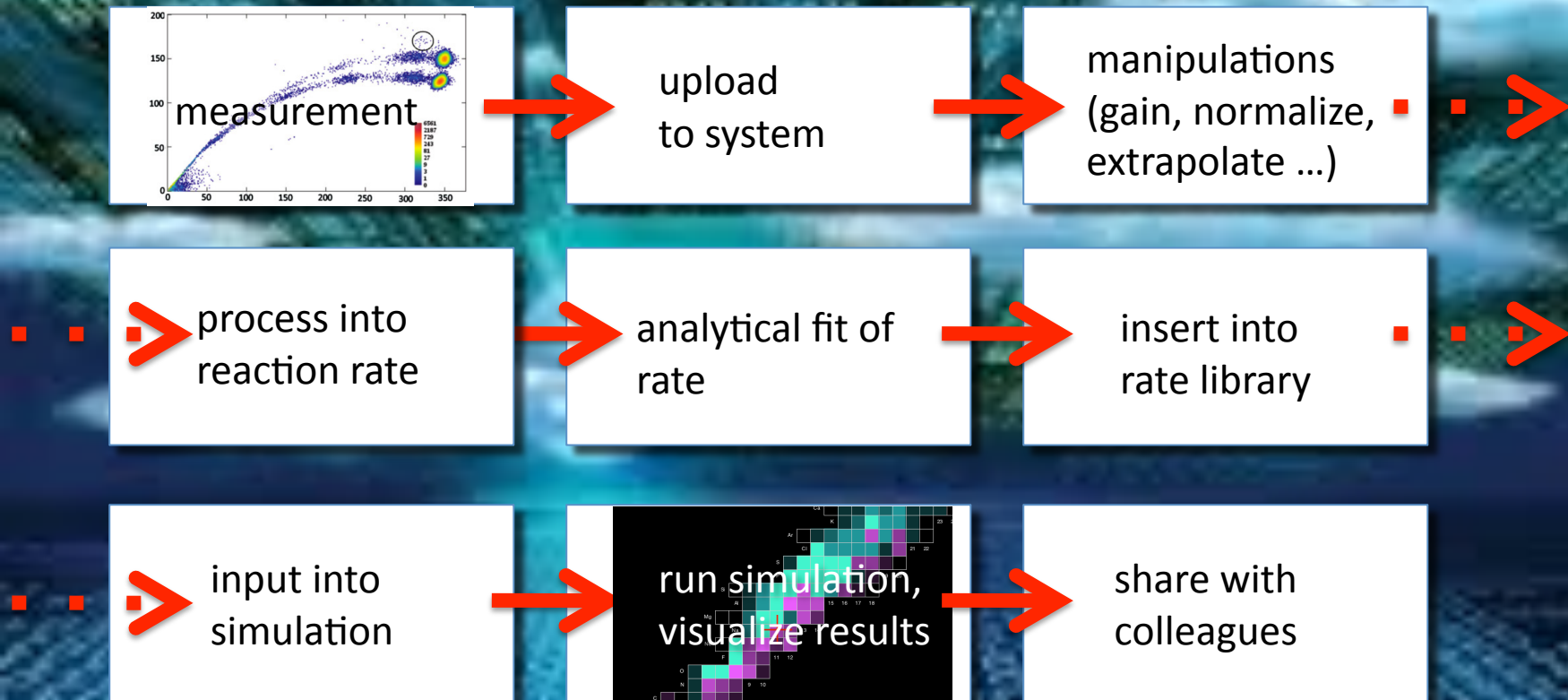
michael smith ornl

virtual pipeline



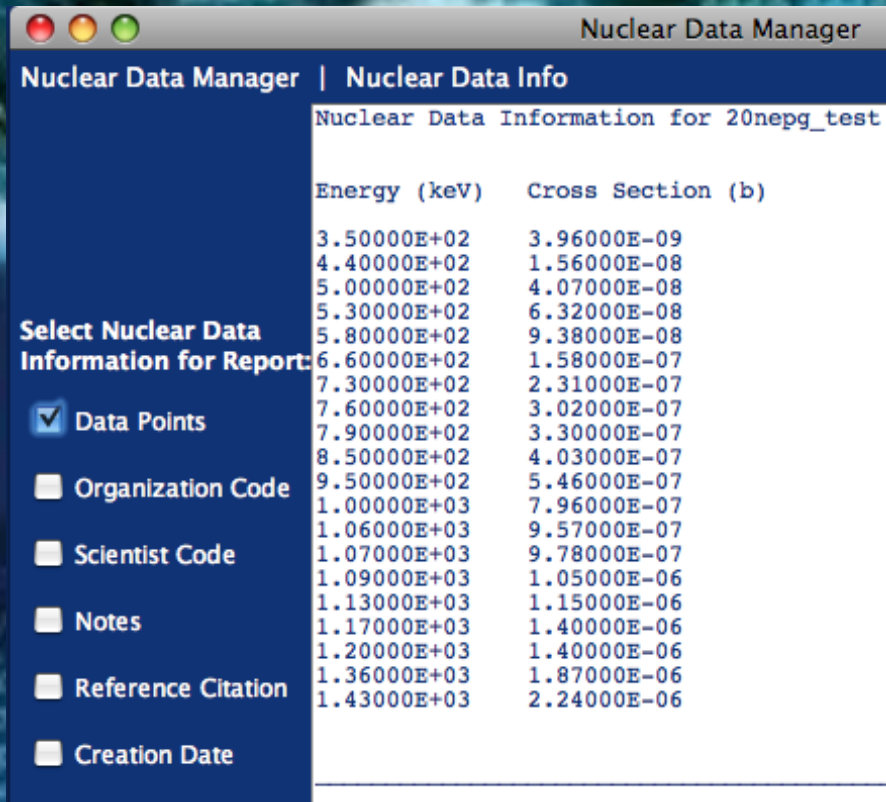
- **INTEGRATION** OF DATA COLLECTION, PROCESSING, VISUALIZATION, MANAGEMENT, & END-USER APPLICATIONS ...

virtual pipeline



- CREATED THE FIRST **VIRTUAL "PIPELINE"** FROM THE NUCLEAR LABORATORY TO ASTROPHYSICS CODES

virtual pipeline



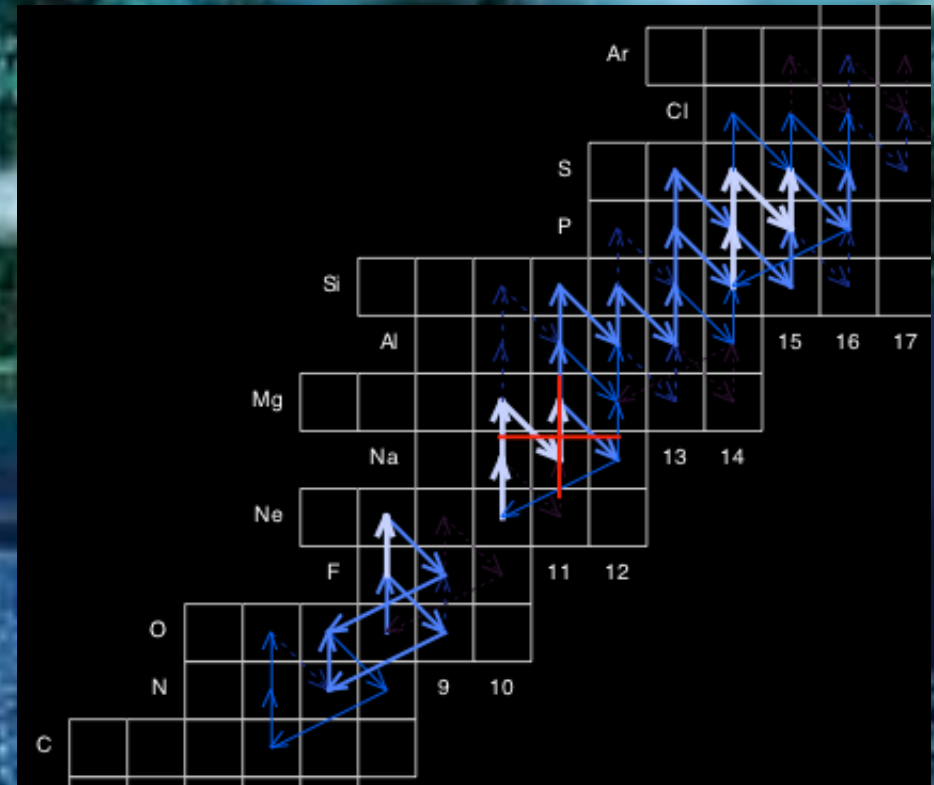
Nuclear Data Manager | Nuclear Data Info

Nuclear Data Information for 20nepg_test

Energy (keV)	Cross Section (b)
3.50000E+02	3.96000E-09
4.40000E+02	1.56000E-08
5.00000E+02	4.07000E-08
5.30000E+02	6.32000E-08
5.80000E+02	9.38000E-08
6.60000E+02	1.58000E-07
7.30000E+02	2.31000E-07
7.60000E+02	3.02000E-07
7.90000E+02	3.30000E-07
8.50000E+02	4.03000E-07
9.50000E+02	5.46000E-07
1.00000E+03	7.96000E-07
1.06000E+03	9.57000E-07
1.07000E+03	9.78000E-07
1.09000E+03	1.05000E-06
1.13000E+03	1.15000E-06
1.17000E+03	1.40000E-06
1.20000E+03	1.40000E-06
1.36000E+03	1.87000E-06
1.43000E+03	2.24000E-06

Select Nuclear Data Information for Report:

- ☒ Data Points
- ☐ Organization Code
- ☐ Scientist Code
- ☐ Notes
- ☐ Reference Citation
- ☐ Creation Date

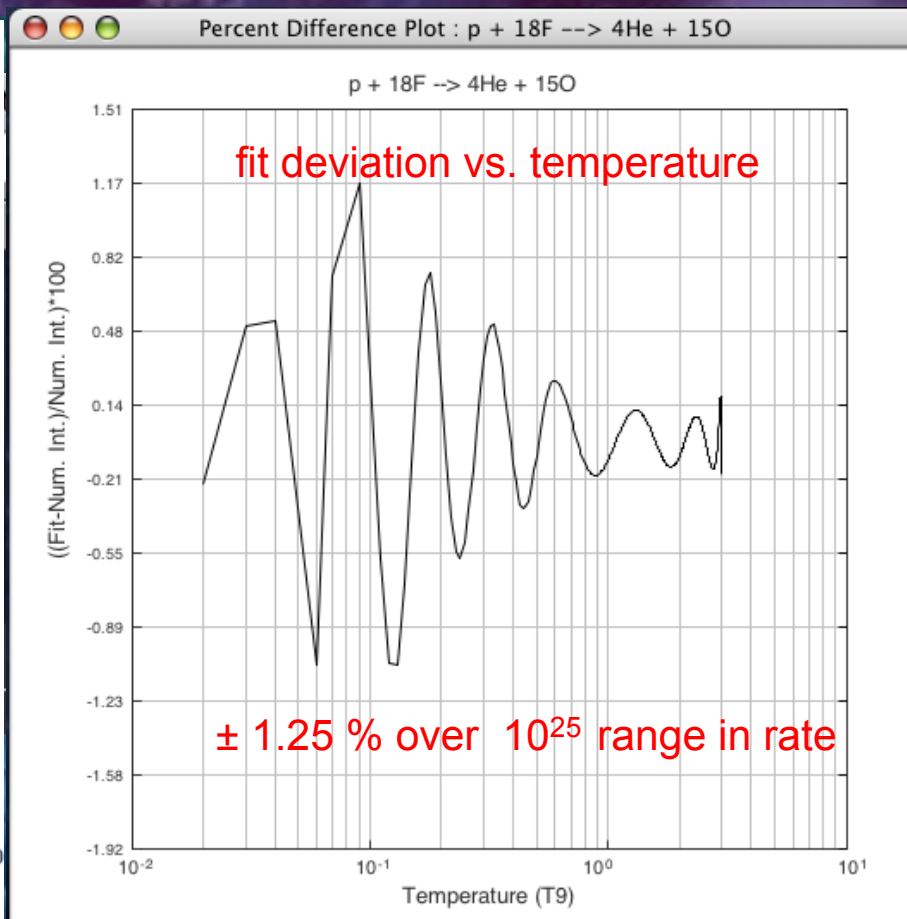
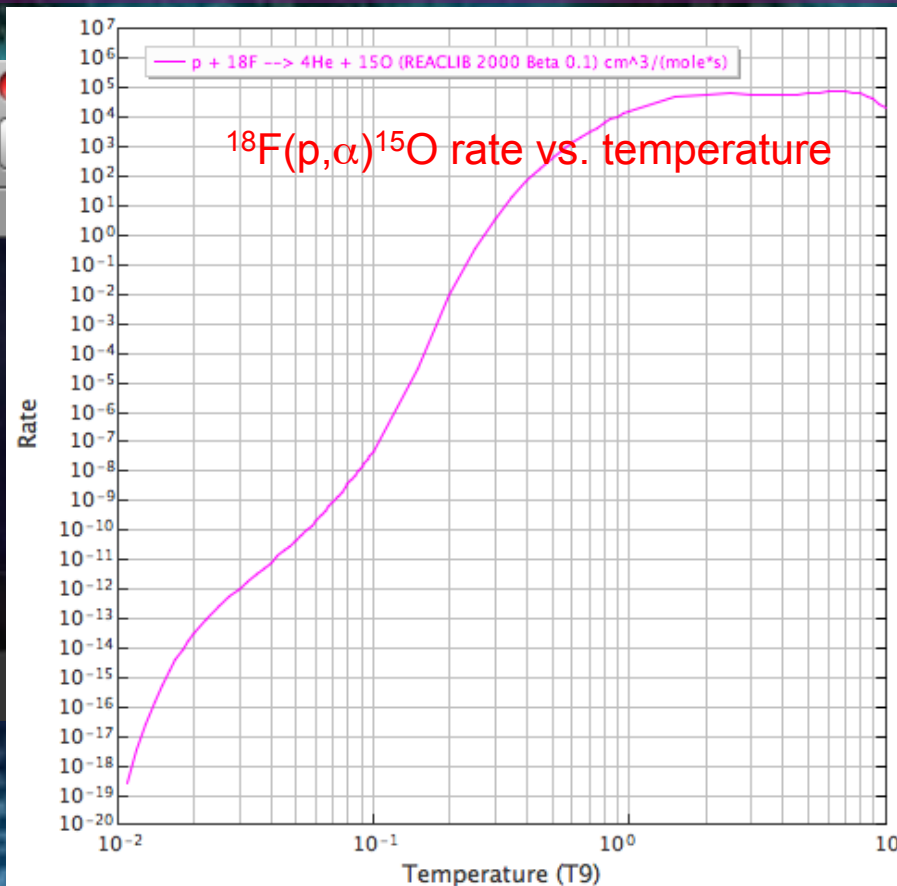


- SEAMLESSLY MERGING NUCLEAR MANIPULATIONS WITH ASTRO SIMULATIONS, ALL "IN THE CLOUD"

cloud computing for nuclear data

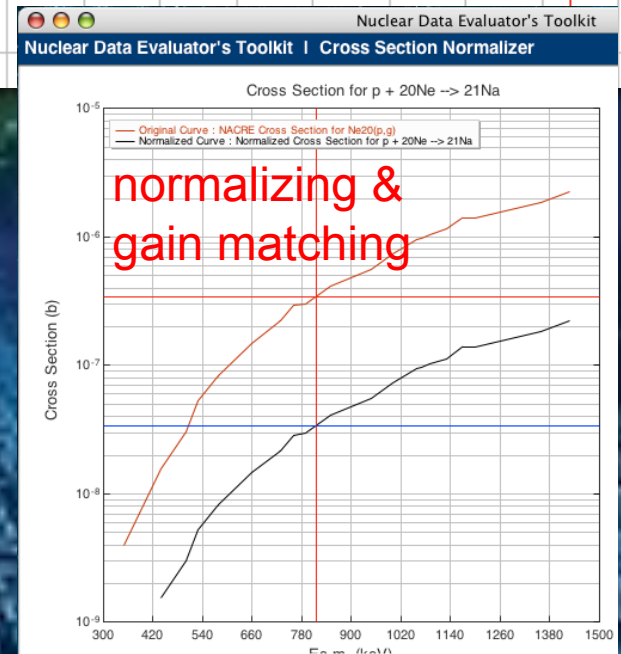
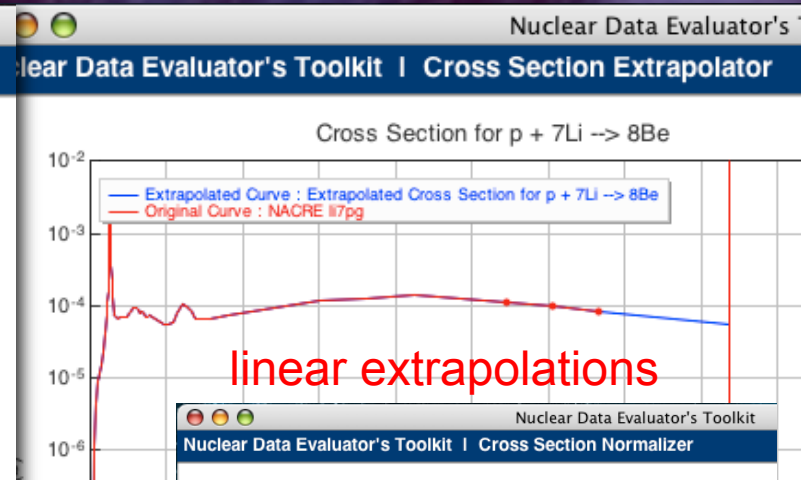
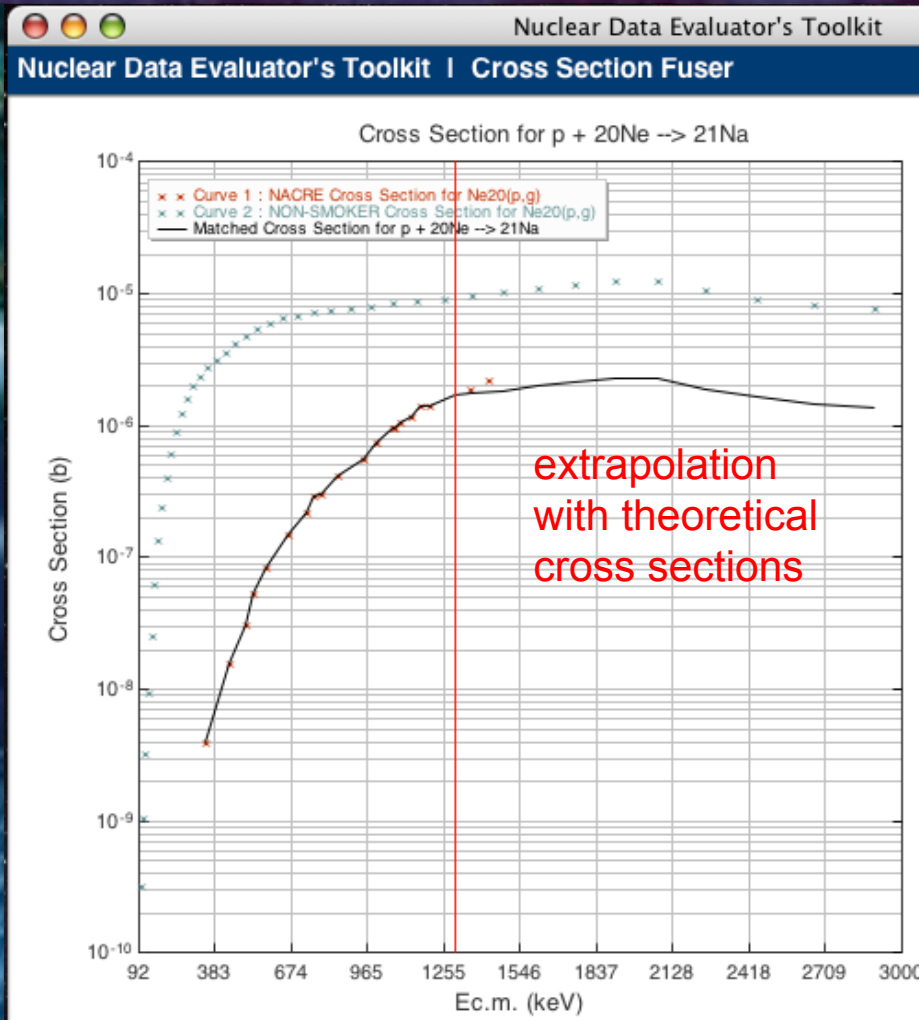
michael smith ornl

cloud computing



- NUCASTRODATA.ORG HAS BEEN OPERATING "IN THE CLOUDS" WITH "RICH INTERNET APPS" SINCE 2004
- EXAMPLE IS OUR CODE GIVING **ANALYTIC FITS** TO POINTWISE REACTION RATES TO 2 % PRECISION **OVER ~30 ORDERS OF MAGNITUDE**

cloud computing



- WE OFFER A NUMBER OF **UTILITY CODES** IN A "NUCLEAR DATA TOOLKIT"

cloud computing – end user applications

Computational Methods for Nucleosynthesis and Nuclear Energy Generation

W. Raphael Hix^{a,b,c} Friedrich-Karl Thielemann^{d,c}

^aJoint Institute for Heavy Ion Research, Oak Ridge National Laboratory, P.O. Box 2008, Oak Ridge, TN 37831-6374

^bDepartment of Physics and Astronomy, University of Tennessee, Knoxville, TN 37996-1200

^cPhysics Division, Oak Ridge National Laboratory, P.O. Box 2008, Oak Ridge, TN 37831-6373

^dDepartment für Physik und Astronomie, Universität Basel, CH-4056 Basel, Switzerland

Abstract

This review concentrates on the two principle methods used to evolve nuclear abundances within astrophysical simulations, evolution via rate equations and via equilibria. Because in general the rate equations in nucleosynthetic applications form an extraordinarily stiff system, implicit methods have proven mandatory, leading to the need to solve moderately sized matrix equations. Efforts to improve the performance of such rate equation methods are focused on efficient solution of these matrix equations, by making best use of the sparseness of these matrices. Recent work to produce hybrid schemes which use local equilibria to reduce the computational cost of the rate equations is also discussed. Such schemes offer significant improvements in the speed of reaction networks and are accurate under circumstances where calculations with complete equilibrium fail.

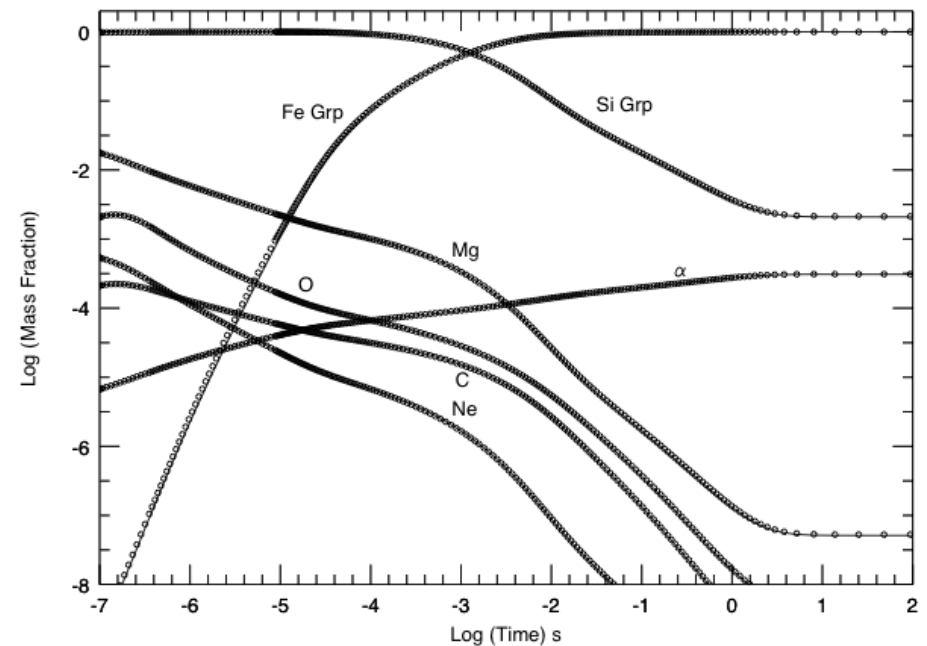


Fig. 4. Evolution of the independent nuclear mass fractions for constant thermodynamic conditions, $T = 5 \text{ GK}$ and $\rho = 10^9 \text{ g cm}^{-3}$. The solid lines display the evolution due to a conventional α -network, the circles show the evolution by the QSE-reduced α network.

$$\left. \frac{\partial n_i}{\partial t} \right|_{\rho=\text{const}} = \sum_j \mathcal{N}_j^i r_j + \sum_{j,k} \mathcal{N}_{j,k}^i r_{j,k} + \sum_{j,k,l} \mathcal{N}_{j,k,l}^i r_{j,k,l}, \quad (11)$$

- THE POPULAR NUCLEOSYNTHESIS CODE **XNET** [HIX & THIELEMAN] IS **INTEGRATED** INTO OUR "CLOUD"

cloud computing – end user applications

Computational Methods for Nucleosynthesis and Nuclear Energy Generation

W. Raphael Hix^{a,b,c} Friedrich-Karl Thielemann^{d,c}

^aJoint Institute for Heavy Ion Research, Oak Ridge National Laboratory, P.O. Box 2008, Oak Ridge, TN 37831-6374

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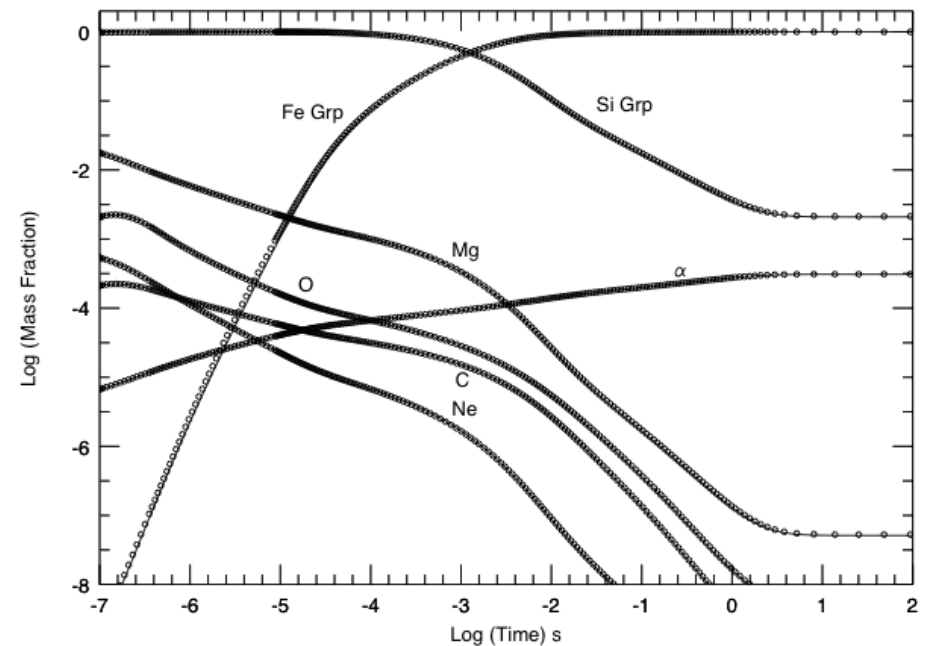


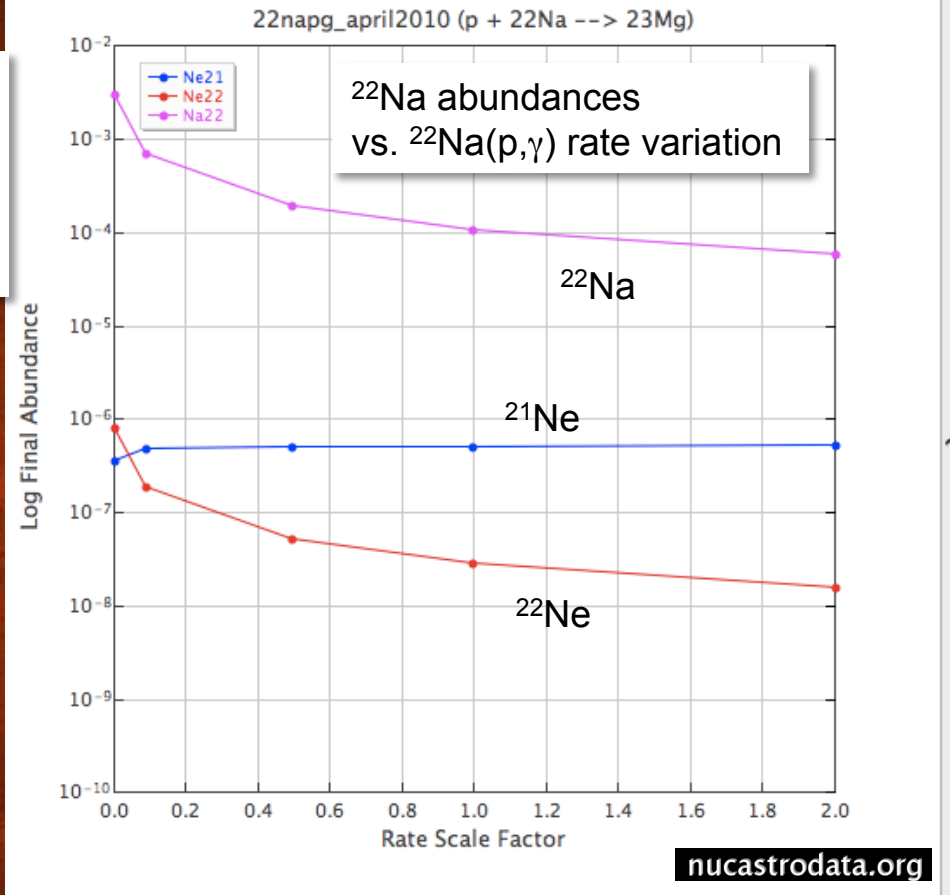
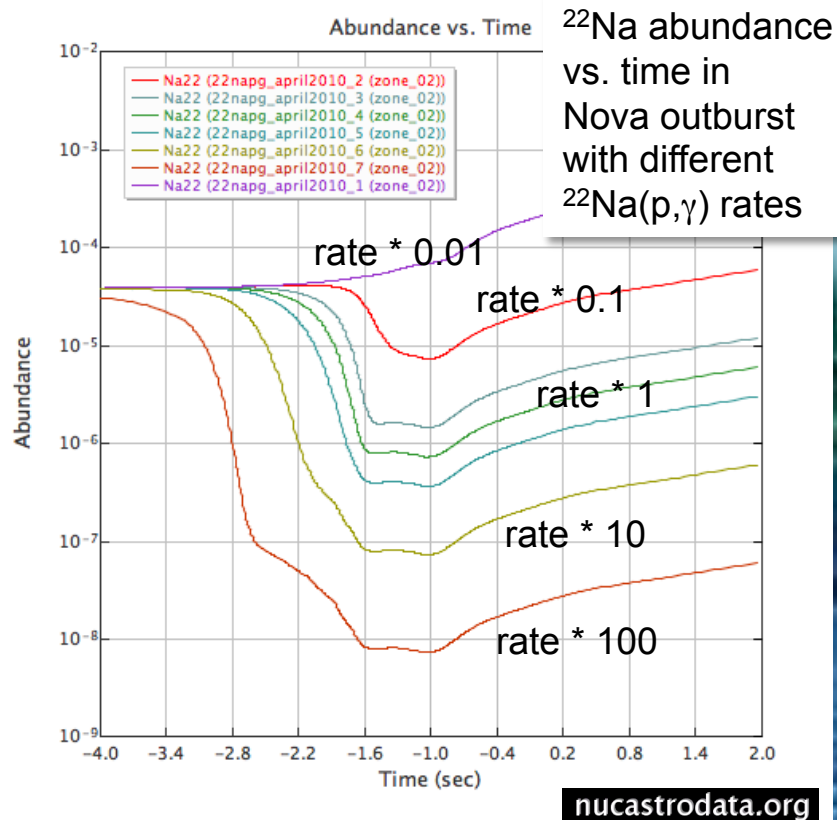
Fig. 4. Evolution of the independent nuclear mass fractions for constant thermodynamic conditions, $T = 5 \text{ GK}$ and $\rho = 10^9 \text{ g cm}^{-3}$. The solid lines display the evolution due to a conventional α -network, the circles show the evolution by the QSE-reduced α network.

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- STREAMLINE EXECUTION OF XNET, STORE RESULTS
- EASY TO USE CUSTOM INPUT NUCLEAR DATA SETS

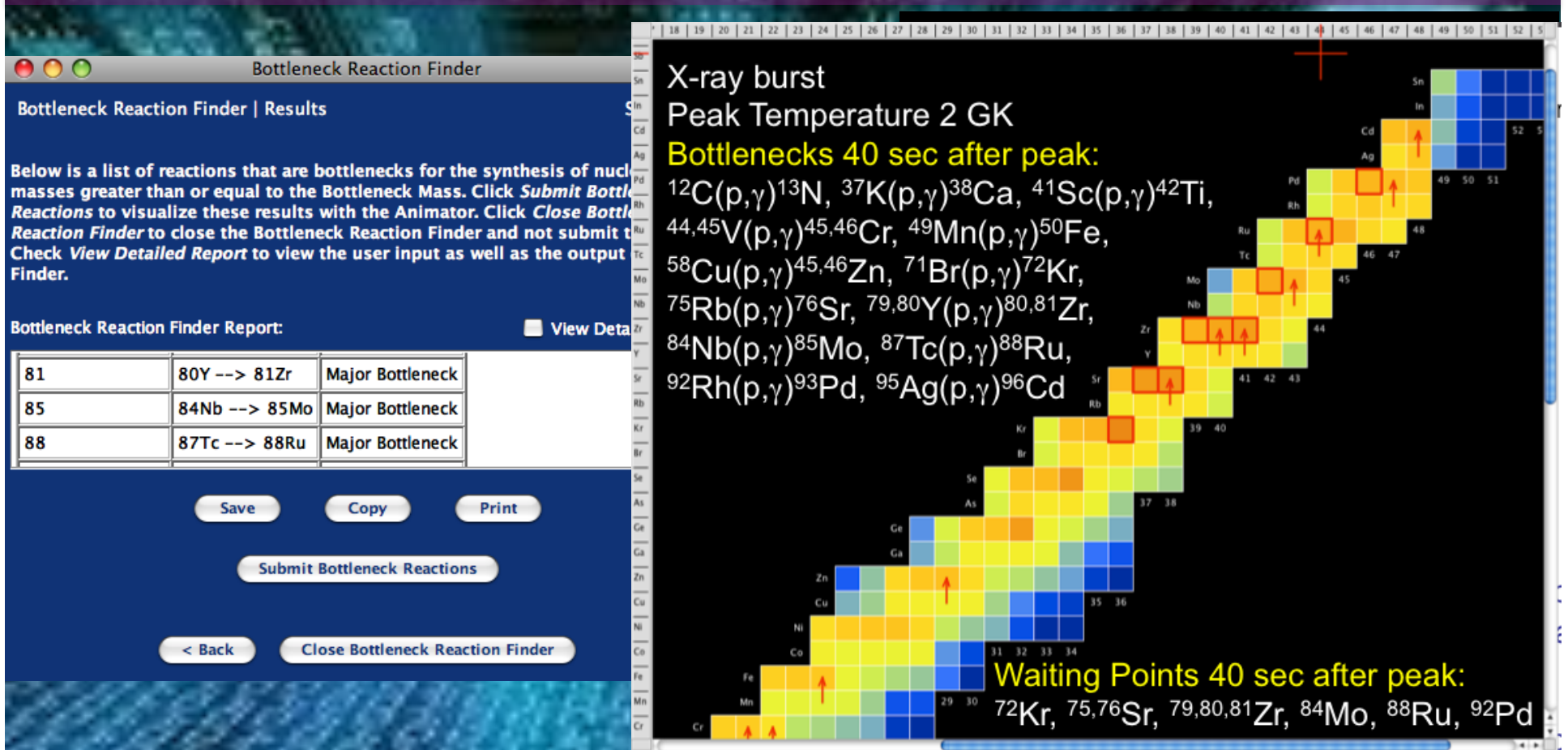
cloud computing – end user applications

Abundance Plotting Interface | Plot Abundance or Ratio of Abundance



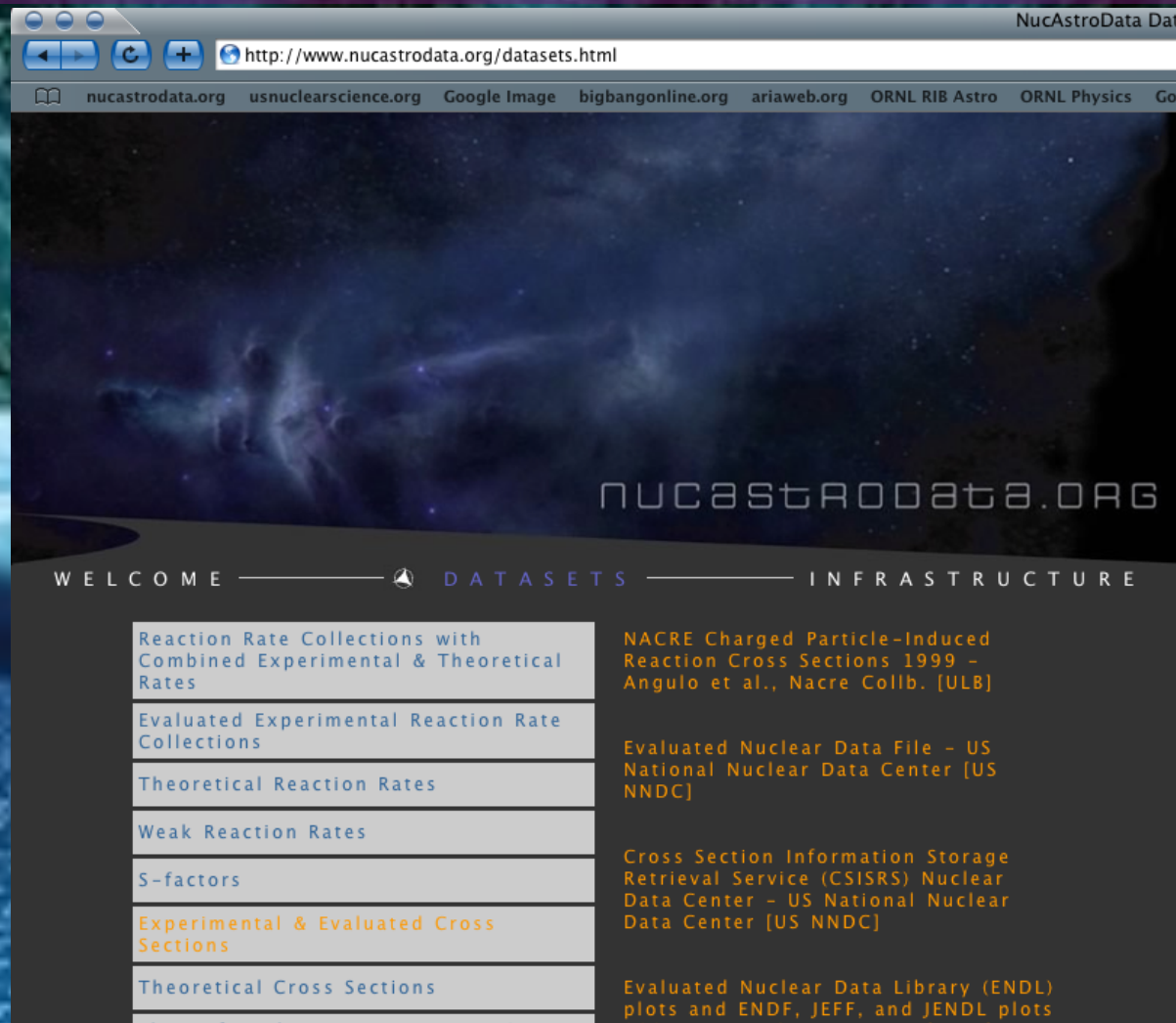
- **SENSITIVITY STUDIES:** MULTIPLE CODE RUNS TO DETERMINE DEPENDENCE OF OUTPUT ON INPUT
- NOW **AUTOMATED** WITH 20-FOLD PRODUCTIVITY INCREASE & ELIMINATION OF BOOK KEEPING ERRORS

cloud computing – end user applications



- MOVE BEYOND EXECUTION & VISUALIZATION TO **ANALYSIS** OF RESULTS
- EXAMPLE: UNIQUE, CUSTOM, **AUTOMATIC SEARCHES** FOR **BOTTLENECK REACTIONS** AND **WAITING POINT NUCLEI** IN NOVAE & X-RAY BURST SIMULATIONS

information sharing - database access



- NUCASTRODATA.ORG **LINKS** TOGETHER OVER 70 SETS OF NUCLEAR PHYSICS & NUCLEAR ASTRO DATA

cloud computing for nuclear data

michael smith ornl

information sharing - file repository

The image shows two overlapping windows. The left window is the 'Repository Manager | File Manager' application. It has a blue header and a main area with the text 'Selected Folder : nuclearmasses_20080716'. Below this, it says 'With this tool, you can download or upload files by changing the File download using the table below.' There is a 'File Manager Mode : Download Files' button. At the bottom, there is a table with columns: Filename, Owner, Creation Date, and Modification Date. The table lists several files: mass8.png, mass6.png, mass2.png, and mass13.png, all owned by Michael Smith and created on 8/16/08. Below the table are buttons for 'Select All Files', 'Clear All Selections', 'Download Selected Files', and 'Download as ZIP File'. At the very bottom are buttons for '< Back', 'Close Repository Manager', and 'Repository'. The right window is a web browser showing the 'NUCASTRODATA File Repository' website. The address bar shows 'http://s1.nucastrodata.org/repository_index.html?FLDIDX=5'. The website has a dark background with the text 'FILE REPOSITORY' and 'NUCASTRODATA.ORG'. Below this is a table titled 'NUCASTRODATA File Repository' with columns 'Folder Name', 'File Name', and 'Size'. The table lists folders 'lingerfelt_20080721' (52K) and 'nuclearmasses_20080716'. Under 'nuclearmasses_20080716', there is a list of files: mass1.png (22.4 K), mass10.png (148.5 K), mass11.png (93.0 K), mass12.png (15.3 K), mass2.png (44.6 K), mass3.png (22.5 K), mass4.png (18.0 K), mass5.png (46.8 K), mass6.png (96.6 K), mass7.png (68.4 K), and mass8.png (90.4 K).

Filename	Owner	Creation Date	Modification Date
mass8.png	Michael Smith	8/16/08 2:59 PM	0000-00-00 00:00
mass6.png	Michael Smith	8/16/08 2:58 PM	0000-00-00 00:00
mass2.png	Michael Smith	8/16/08 2:57 PM	0000-00-00 00:00
mass13.png	Michael Smith	8/16/08 2:56 PM	0000-00-00 00:00

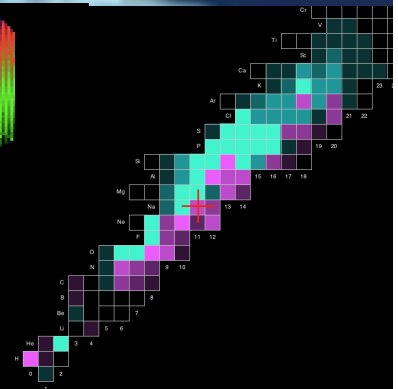
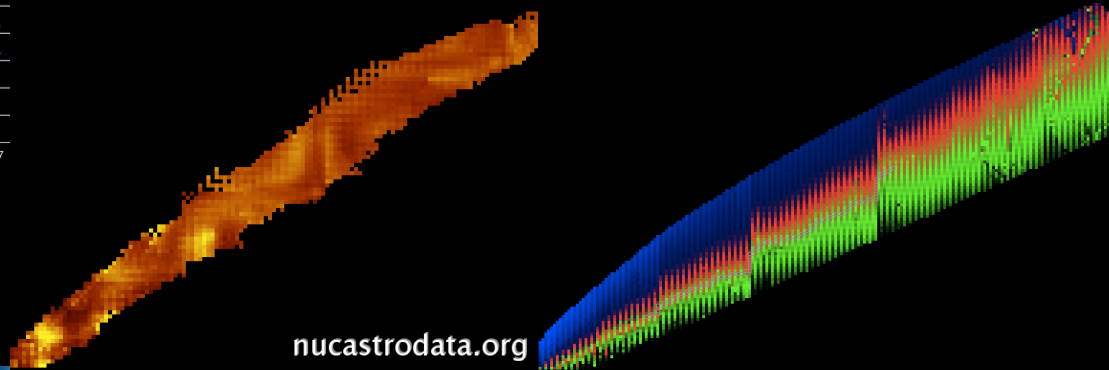
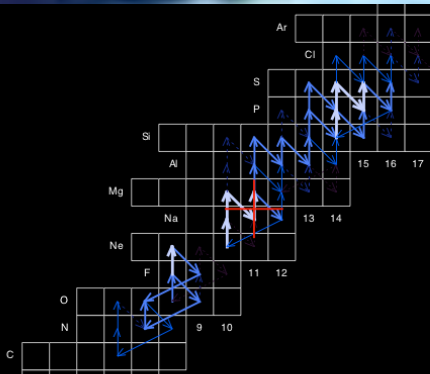
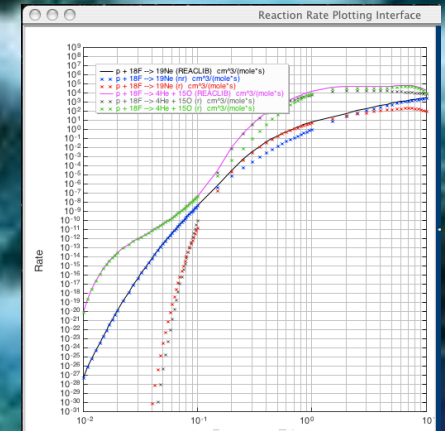
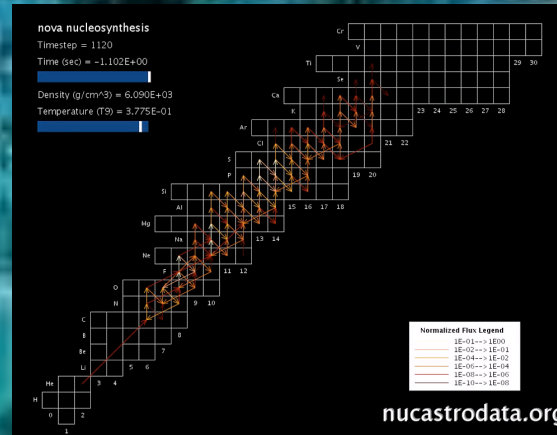
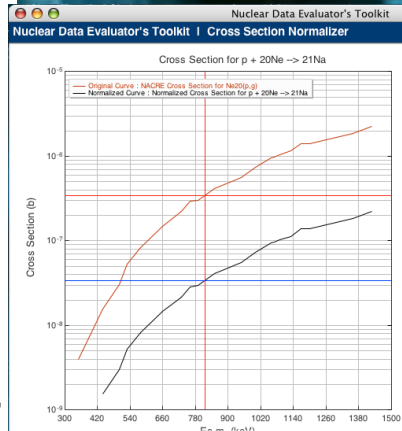
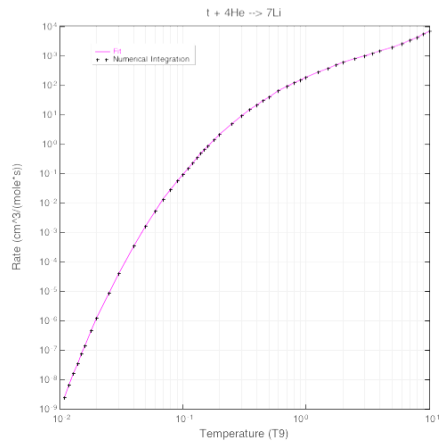
Folder Name	File Name	Size
lingerfelt_20080721		52K
nuclearmasses_20080716		
	mass1.png	22.4 K
	mass10.png	148.5 K
	mass11.png	93.0 K
	mass12.png	15.3 K
	mass2.png	44.6 K
	mass3.png	22.5 K
	mass4.png	18.0 K
	mass5.png	46.8 K
	mass6.png	96.6 K
	mass7.png	68.4 K
	mass8.png	90.4 K

- ALLOWS QUICK SHARING OF FILES IN 32 FORMATS
- UPLOAD QUICKLY, VIEW OVER WEB OR WITHIN SUITE

cloud computing for nuclear data

michael smith ornl

data visualization

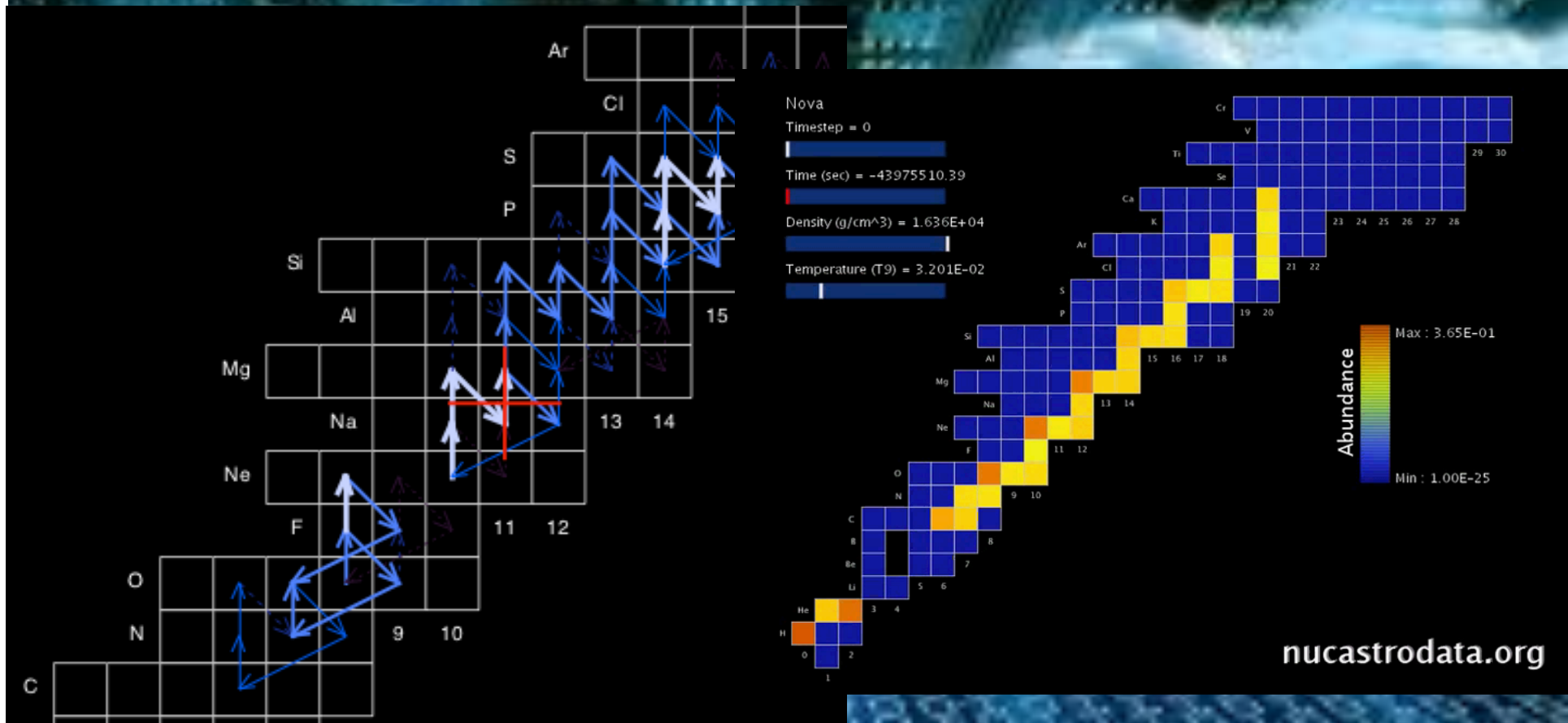


- MOVE BEYOND TEXT TABLES, LINE PLOTS
- DYNAMIC, MULTI-D, ANIMATED, INTERACTIVE PLOTS ARE ESSENTIAL RESEARCH TOOLS
- TREND: USE VIZ TOOLS "IN THE CLOUDS" TO SAVE YOUR DEVELOPMENT TIME

cloud computing for nuclear data

michael smith ornl

data visualization

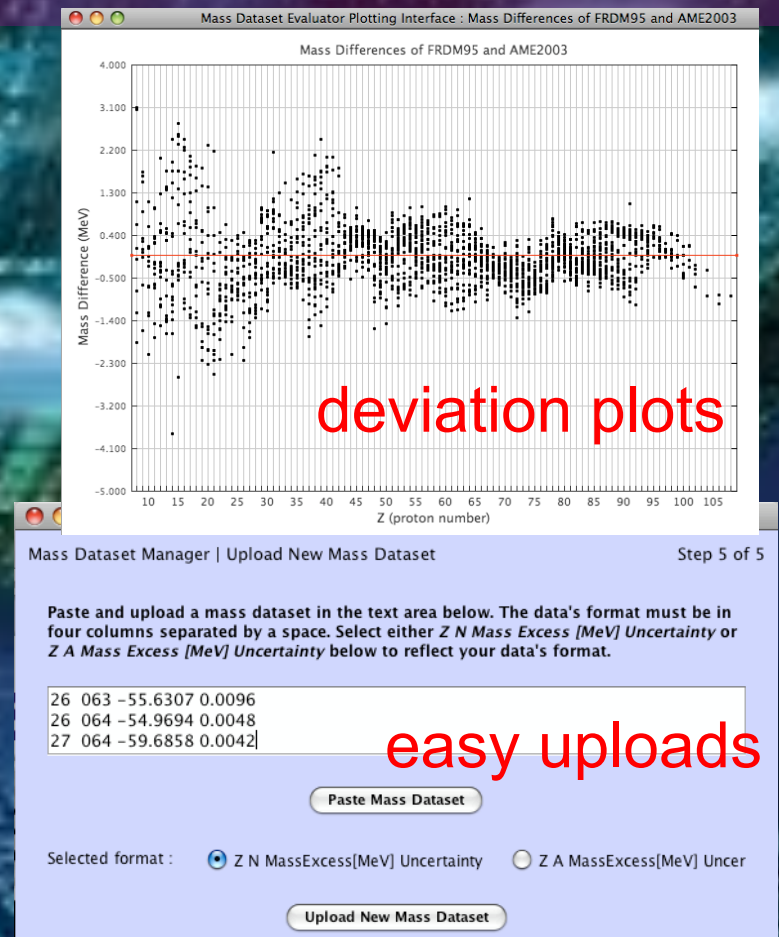
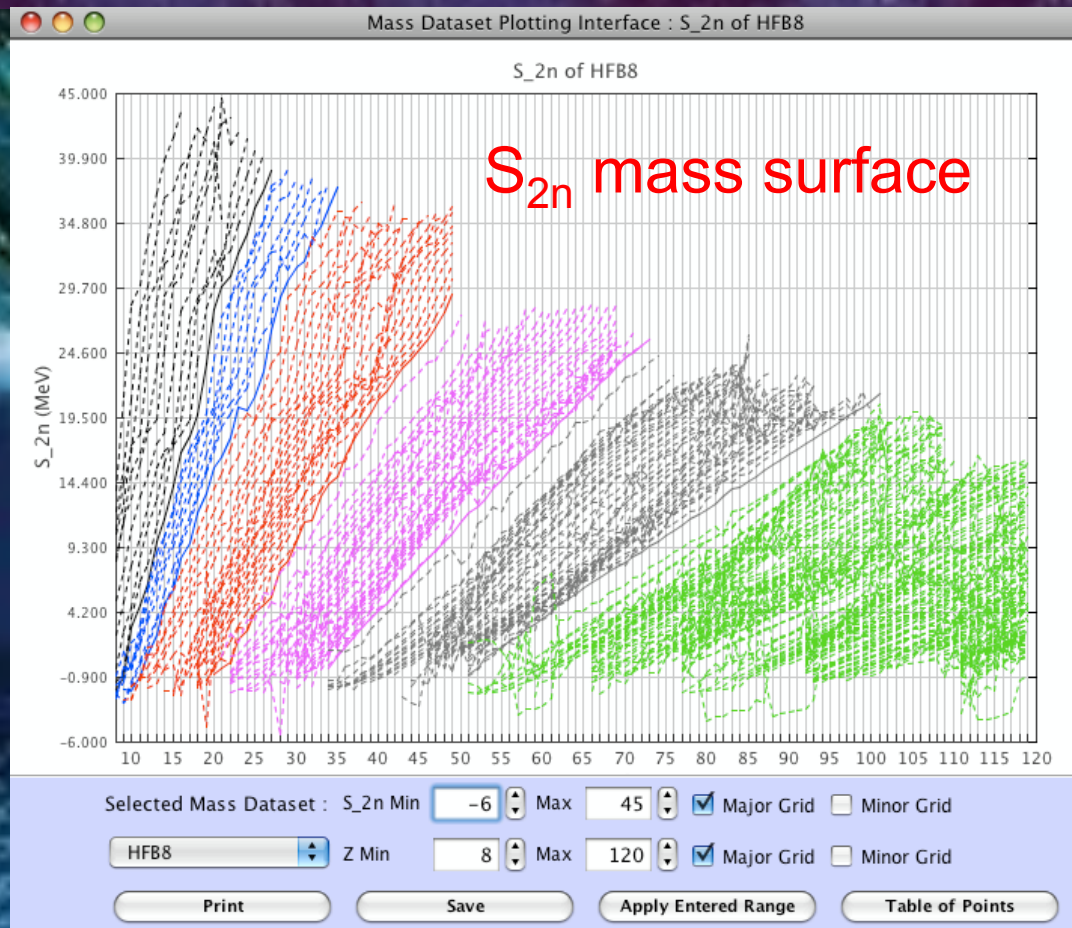


- COMPUTATIONAL INFRASTRUCTURE FOR NUCLEAR ASTROPHYSICS FEATURES 2 - D ANIMATED PLOTS FOR NUCLEAR BURN CALCULATIONS
 - REACTION FLOW VS. TIME
 - ABUNDANCE VS. TIME

cloud computing for nuclear data

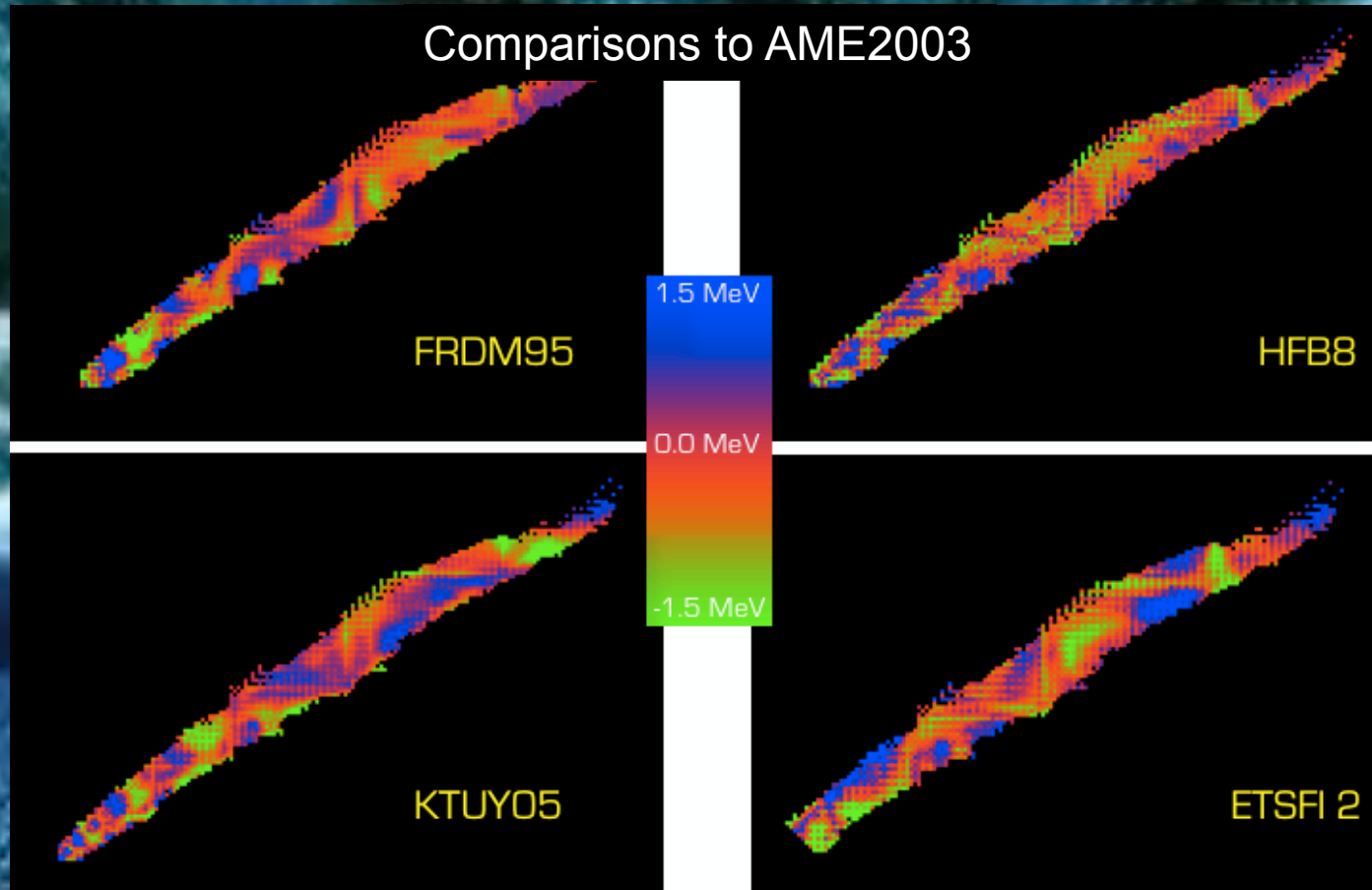
michael smith ornl

data visualization



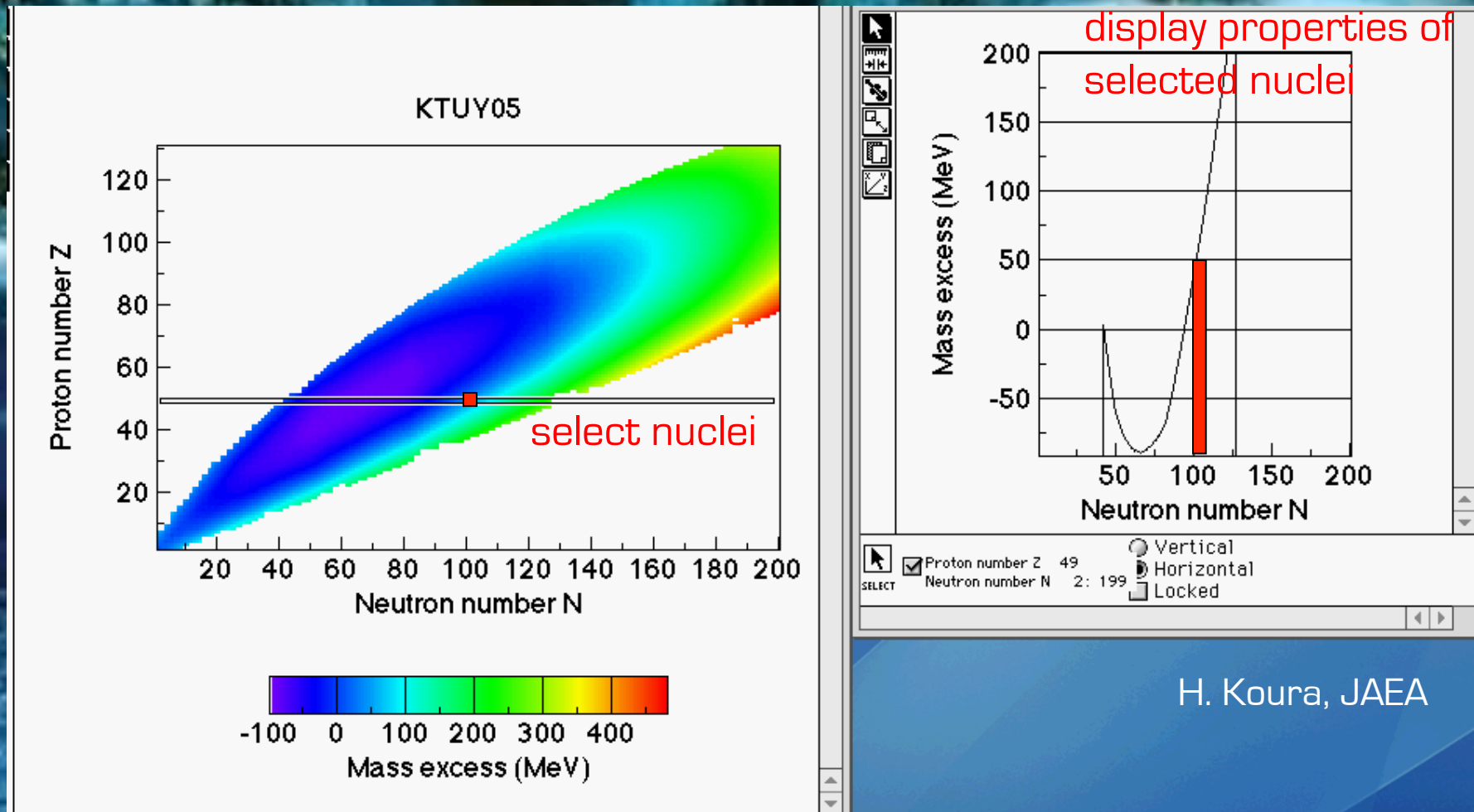
- **NUCLEARMASSES.ORG** ADVANCES MASS DATASETS FROM TEXT TABLES TO DYNAMIC 1D & 2D PLOTS
- INTEGRATES **UPLOADING** OF DATA SETS WITH **PLOTTING** AND **ANALYSIS** TOOLS

data visualization



- NUCLEARMASSSES.ORG ADVANCES MASS DATASETS FROM TEXT TABLES TO DYNAMIC 1D & 2D PLOTS
- QUICK **COMPARISONS** OF DATASETS (THEORY, EXPERIMENTAL, EVALUATED) OVER **MANY PARAMETERS**

data visualization



H. Koura, JAEA

- FUTURE FEATURE AT NUCLEARMASSES.ORG:
INTERACTIVE MASS PLOTS

cloud computing for nuclear data

michael smith ornl

information sharing

real control parameters=

```
acrate= 1.00D+16    alpha = 0.00D+00    alte = 0.00D+00    dccmax= 5.50D+05    dmstar= 1.00D-22
dumax = 1.00D-01    dwnmax = 1.00D-02    dzmax = 1.00D-02    eqtol = 1.00D-04    fudge = 1.00D+00
rmstar= 2.68D+33    timadv= 1.00D+00    tsincr= 1.40D+00    uslop = 1.00D+07    utol = 1.00D-04
visc = 2.00D+00    wtol = 1.00D-04    ztol = 1.00D-04    balpha= 0.00D+00    new = 1.00D+00
dotm = 1.59D-10    ratmas= 1.19D+00    baccr = 0.00D+00    bkappa= 1.00D+00    accdel= 0.00D+00
fracma= 0.10D+01    soslim = 1.00D+12    pram = 0.00D+00    radprs = 3.71D+04
```

integer control parameters

```
icomp = 69    icpum1=
nrezon= 95    jconv =
nzone = 95    mdebug1=1f
```

logical control parameters

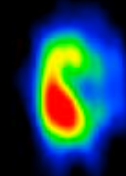
```
xaccre= T    xdiff = F    xdtim= F    xchek= F    xevol= T    xrezon= F    xdown= F    xtape = T
```

```
bcore= 0.00D+00    pram= 0.00D+00    radprs= 3.71D+04    y2(i)* 1.00D+00    radbnd* 1.00D+00    n2time= 1
```

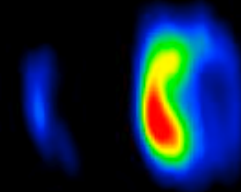
1	i	qface	qlface	r	b	t	rho	p	kappa	mass
1	9.99993D-01	7.44982D-06	4.34249D-01	0.00000D+00	7.04139D+00	8.95404D+00	2.66129D+01	-1.86319D+01	4.28681D+32	
2	8.40330D-01	1.59678D-01	7.68533D+00	-6.66449D-08	7.04139D+00	8.79292D+00	2.63946D+01	-1.81580D+01	3.60236D+32	
3	7.06160D-01	2.93840D-01	7.80064D+00	-1.44735D-07	7.04139D+00	8.65525D+00	2.62082D+01	-1.77492D+01	3.02719D+32	
4	5.93411D-01	4.06589D-01	7.87169D+00	-1.21636D-02	7.04759D+00	8.52965D+00	2.60381D+01	-1.73441D+01	2.54386D+32	
5	4.98665D-01	5.01335D-01	7.92399D+00	-2.23567D-02	7.05585D+00	8.41210D+00	2.58789D+01	-1.69504D+01	2.13770D+32	
6	4.19046D-01	5.80954D-01	7.96571D+00	-2.72306D-02	7.06370D+00	8.30064D+00	2.57279D+01	-1.65740D+01	1.79639D+32	
7	3.52140D-01	6.47860D-01	8.00054D+00	-2.03553D-02	7.06855D+00	8.19413D+00	2.55837D+01	-1.62236D+01	1.50957D+32	
8	2.95916D-01	7.04084D-01	8.03046D+00	3.37144D-02	7.06142D+00	8.09184D+00	2.54451D+01	-1.59359D+01	1.26854D+32	
9	2.48669D-01	7.51331D-01	8.05669D+00	9.79356D-02	7.04139D+00	7.99352D+00	2.53116D+01	-1.57100D+01	1.06600D+32	

Nova RS Ophiuchi simulation
Hydrodynamics 1D + thermonuclear burn
Sumner Starrfield [Arizona State Univ.],
Tomomi Sunayama [Yale],
Raph Hix & MSS [ORNL]

Nova RS Ophiuchi



21 days



27 days

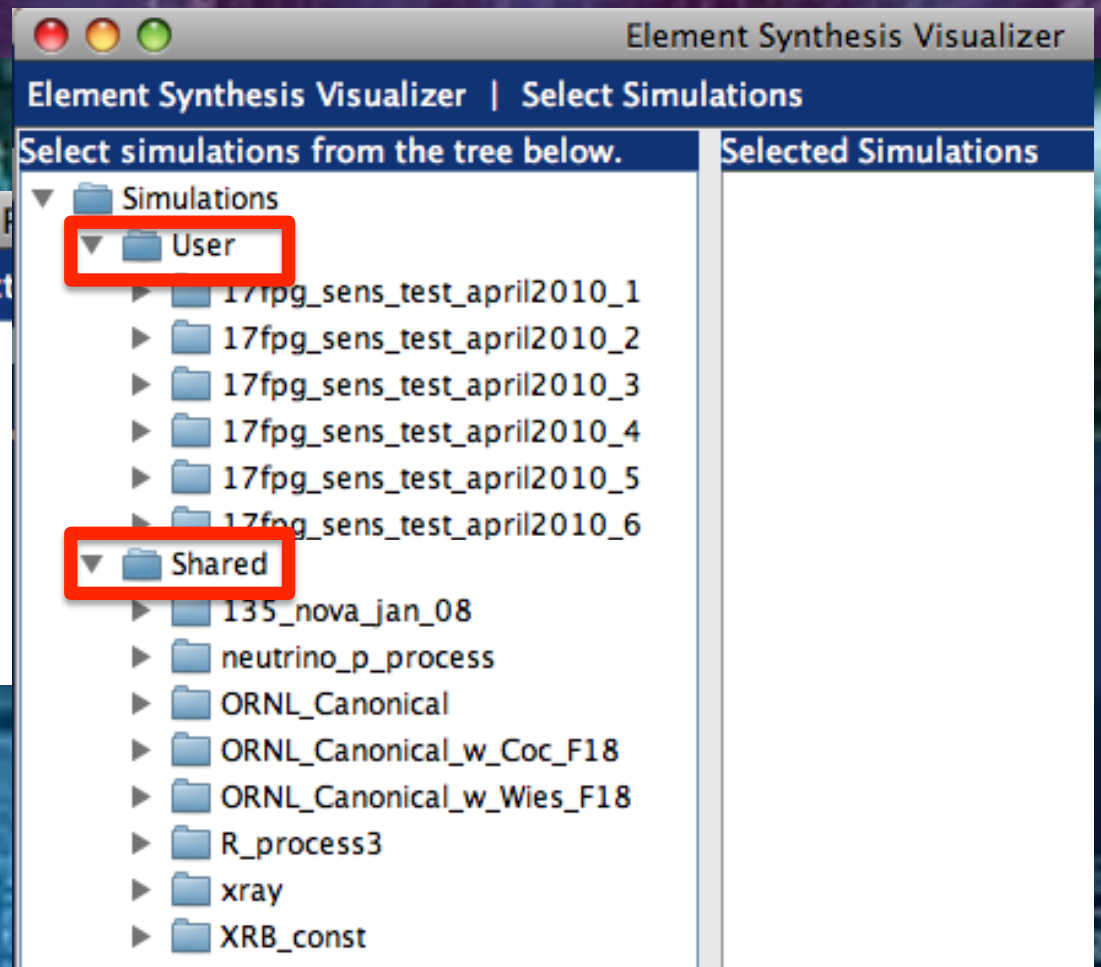
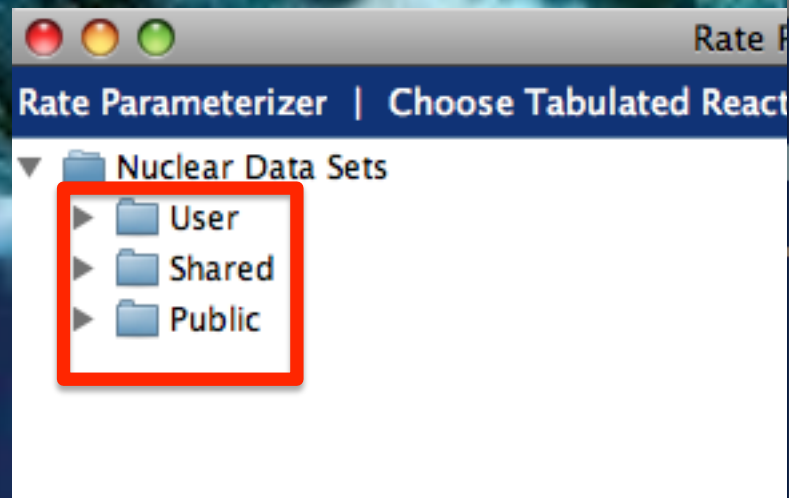
Very Long Baseline Array

- MANY DATA SETS TOO LARGE TO EMAIL, FTP OFTEN CLUMBERSOME
- WE BUILT MECHANISMS TO **SHARE** DATA SETS & DOCUMENTS **EASILY WITH COLLEAGUES**
- **SUBSCRIBER** MODEL: REGISTER FOR FREE DISK SPACE

cloud computing for nuclear data

michael smith ornl

information sharing



- OUR SYSTEM FEATURES **USER [PRIVATE]**, **SHARED**, AND **PUBLIC DATA SPACES**
- EASY TO **SHARE** LARGE CLUMBERSOME DATASETS AND USE WITH ALL OUR DATA/VIZ/SIM TOOLS
- FORMS AN **ONLINE COMMUNITY**

information sharing – dataset merging

Rate Library Manager | Merge Existing Libraries Step 1 of 2

Welcome to the Merge Existing Libraries tool.

With this tool you can create a new reaction rate library by performing a prioritized merge of several rate libraries.

Save new library as:

Select a library to merge.

- Iliadis
- REACLIB07
- nucastrodata.org Best
- ORNL Best
- Sample_Lib_1
- ORNL Canonical-2000
- ORNL Canonical w Coc
- fixed XRR

Add Library >>

<< Remove Library

Highest to lowest priority

- NACRE
- REACLIB 2000 Beta 0.1 M

< Back Continue >

50e+01	0.922145e-01	-0.872123e-02	-0.267919e-01
39e-			e+01
81e-			e+01
27e-			e+01
53E-			E+01
81E-			E+01
32E-			E+01
06E-			E+01
55e+03	0.174469e+03	-0.122087e+03	0.921150e+02
37e-09	0.882184e-10	-0.819111e-11	-0.150000e+01
46e+03	-0.209342e+02	0.143301e+01	-0.997276e+02
14e+03	0.576182e+02	-0.255641e+02	0.527043e+02
94e+02	0.506505e+01	-0.291069e+00	0.427415e+02
17e+04	0.867021e+02	-0.388737e+01	0.981427e+03
88E-10	0.429278E-11	-0.349005E-12	0.100000E+01
74E+02	-0.328583E+01	0.260902E+00	-0.101207E+02
89E-09	0.502412E-10	-0.421356E-11	0.100000E+01
84E-10	-0.640029E-11	0.564357E-12	0.100000E+01
67E+01	-0.202393E+00	0.716185E-02	-0.233309E+01
22e+00	-0.154972e+00	0.167096e-01	-0.741063e+00
83e+01	-0.633237e+00	0.402111e-01	-0.511341e+01
10E+02	-0.159811E+01	0.101567E+00	-0.900900E+01
16e-01	0.850627e-02	-0.710869e-02	-0.649310e+00
wiesr p + F18 -> Ne19	0.616502e+02	-0.422268e+01	0.798923e+02
bakar n + F19 -> F20	0.135959e+02	0.000000e+00	0.000000e+00

REACLIB

Rauscher, Thielemann et al.

> 60,000 rates

- **INTEGRATED** TOOLS FOR DATA MODIFICATION / MERGING / MANAGEMENT
 - SPEEDS WORK
 - IMPROVES ACCURACY !!
 - SIMPLIFIES REPETITIVE TASKS

data harvesting

Table of Nuclides

- Cross section plotter
- Table of γ - rays
- Photon/Electron
- Bulletin Board
- 한국 핵자료연구회

Frequently Asked Questions

679393 (c) Nuclear Data Evaluation Lab. Copyright 2000 Korea Atomic Energy Research Institute

Nuclear Data Center
Japan Atomic Energy Agency

Return to Top Page

JENDL-3.3

Summary of JENDL-3.3

Purpose	To provide a Japanese standard library for fast breeder reactors, thermal reactors, fusion neutronics and shielding calculations, and other applications
Number of nuclides	337
Incident neutron energy range	10^{-5} eV to 20 MeV
Format	ENDF-6 Format
Pointwise files	prepared at 0K and 300K

Dataset retrieval by Z, A, or Nuclide

Use this form to select datasets based on atomic number, atomic mass, or nuclide. First, choose the databases and types of dataset (ENSDF or XUNDL, Adopted, Reaction, etc.), then enter the retrieval criterion in the corresponding box below and click the matching "Search" button. For more information, see the [help](#) page.

Databases: ☒ ENSDF ☐ XUNDL

Dataset types: ☒ Adopted ☐ Decay ☐ Reaction ☐ Comments ☐ Reference

Evaluated Nuclear Structure Data File (ENSDF)
Database version of April 16, 2010

Experimental Unevaluated Nuclear Data List (XUNDL)
Database version of April 16, 2010

Experimental Nuclear Reaction Data (EXFOR / CSISRS)

Database Version of February 19, 2010

News

2009/07 Improvements and extensions:
1) Extended using plotting program ZVView via Web [\[about\]](#)

[\[History\]](#)

The Joint Institute for Nuclear Astrophysics

Virtual Journal of Nuclear Astrophysics

JINA - Virtual Journal of Nuclear Astrophysics, 16 April 2010

Volume 8, Issue 16 (15 Articles)

- MANY OF US VISIT THE SAME SITES EVERY TIME WE LAUNCH AN EVALUATION OR INVESTIGATION

cloud computing for nuclear data

michael smith ornl

data harvesting

Table of Nuclides

• Cross section plotter

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[\[History\]](#)

The Joint Institute for Nuclear Astrophysics

Virtual Journal of Nuclear Astrophysics

JINA - Virtual Journal of Nuclear Astrophysics, 16 April 2010

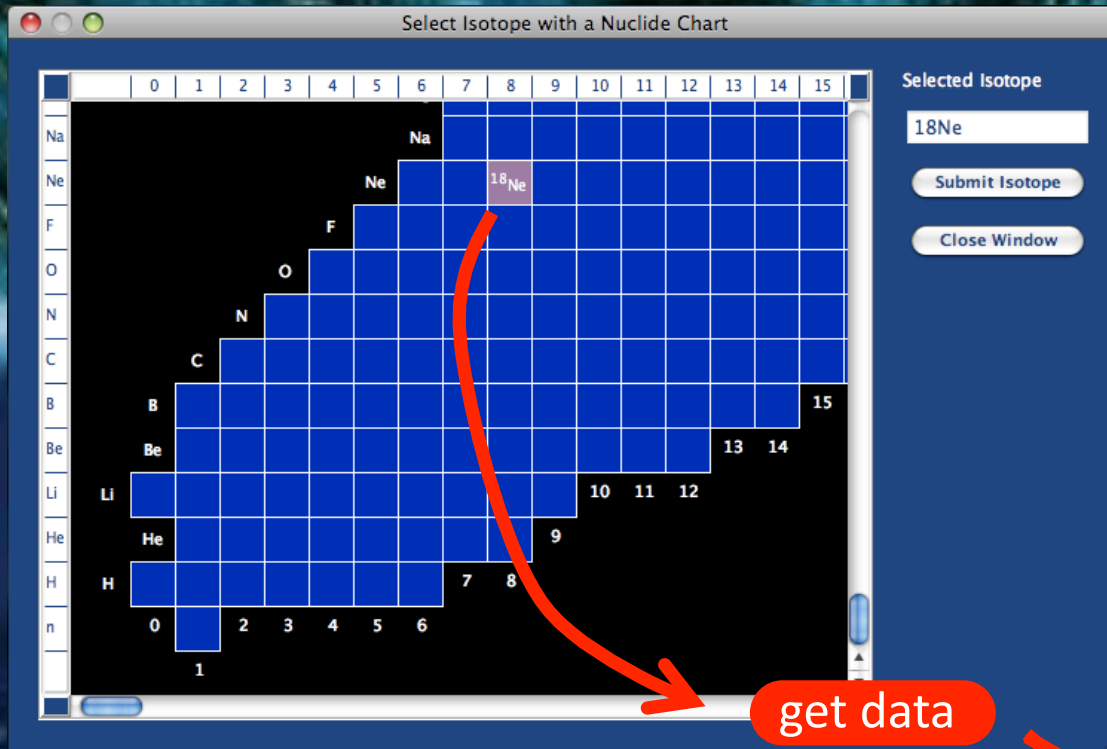
Volume 8, Issue 16 (15 Articles)

- AUTOMATE** THESE REPETITIVE DATA SEARCHES AND RETRIEVALS TO INCREASE PRODUCTIVITY

cloud computing for nuclear data

michael smith ornl

data harvesting

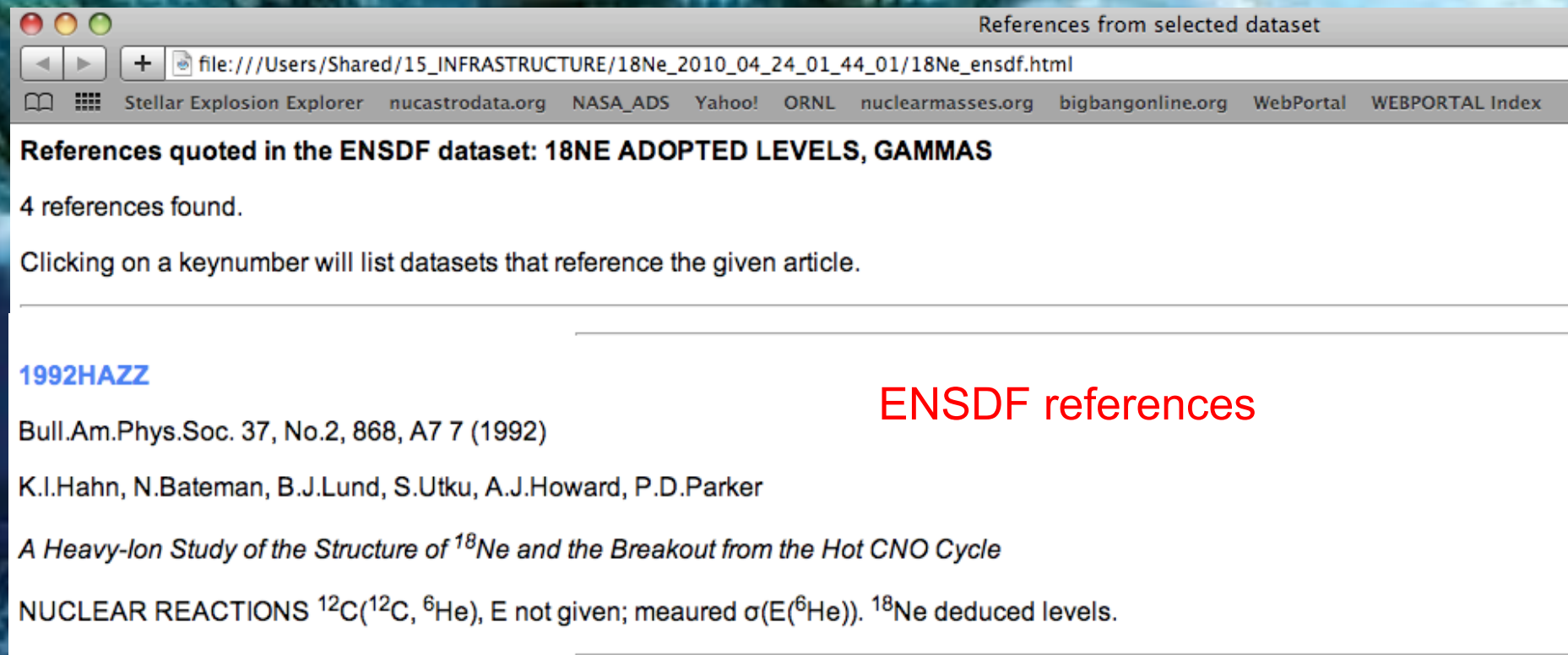


- WE BUILT A "DIGITAL ASSISTANT"
- CHOOSE THE NUCLEUS, IT SEEKS & RETRIEVES (HARVESTS) THE DATA
- DELIVERS TO YOUR DESKTOP / PRIVATE SPACE

cloud computing for nuclear data

michael smith ornl

data harvesting



The screenshot shows a web browser window titled "References from selected dataset". The address bar displays the file path: `file:///Users/Shared/15_INFRASTRUCTURE/18Ne_2010_04_24_01_44_01/18Ne_ensdf.html`. The browser's toolbar includes a search icon and a menu with the following links: Stellar Explosion Explorer, nucastrodata.org, NASA_ADS, Yahoo!, ORNL, nuclearmasses.org, bigbangonline.org, WebPortal, and WEBPORTAL Index.

References quoted in the ENSDF dataset: 18NE ADOPTED LEVELS, GAMMAS

4 references found.

Clicking on a keynumber will list datasets that reference the given article.

1992HAZZ

Bull.Am.Phys.Soc. 37, No.2, 868, A7 7 (1992)

K.I.Hahn, N.Bateman, B.J.Lund, S.Utku, A.J.Howard, P.D.Parker

A Heavy-Ion Study of the Structure of ^{18}Ne and the Breakout from the Hot CNO Cycle

NUCLEAR REACTIONS $^{12}\text{C}(^{12}\text{C}, ^6\text{He})$, E not given; measured $\sigma(E(^6\text{He}))$. ^{18}Ne deduced levels.

ENSDF references

- PROOF OF PRINCIPLE TOOL CREATED, SUCCESSFULLY TESTED, & PUT **ONLINE**
- HARVESTS FROM 5 DATABASES, MANY MORE TO BE ADDED SOON

data harvesting

18Ne_kaeri.html

file:///Users/Shared/15_INFRASTRUCTURE/18Ne_2010_04_24_01_44_01/18Ne_kaeri.html

Stellar Explosion Explorer nucastrodata.org NASA_ADS Yahoo! ORNL nuclearmasses.org bigbangonline.org WebPort

10-Ne-18

[basic](#)

[element](#)

10-neon-18

- Atomic Mass: 18.0056971 +- 0.0000016 amu
- Excess Mass: 5306.782 +- 1.500 keV
- Binding Energy: 132153.495 +- 1.500 keV
- Beta Decay Energy: B- -20011.000 +- 401.000 keV #

"The 1995 update to the atomic mass evaluation" by G.Audi and A.H.Wapstra, Nuclear Physics A595 vol. 4 p.409-480, December 25, 1995.

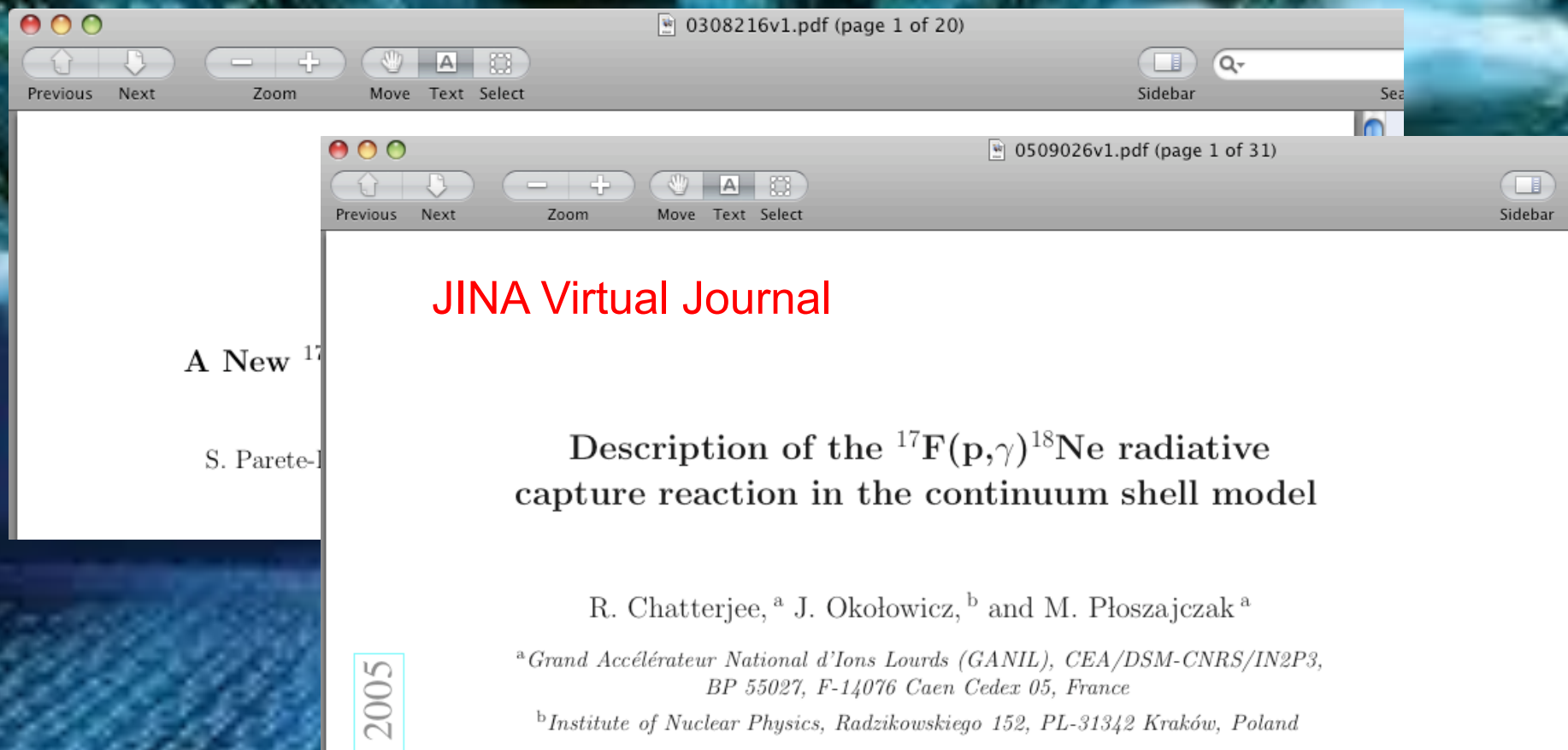
- Spin: 0+
- Half life: 1672 ms
- Mode of decay: [Electron capture](#) to [F-18](#)
 - Decay energy: 4.446 MeV

R.R.Kinsey, et al., *The NUDAT/PCNUDAT Program for Nuclear Data*, paper submitted to the 9 th International Symposium of Capture-Gamma_raySpectroscopy and Re

KAERI Table of Nuclides

- PROOF OF PRINCIPLE TOOL CREATED, SUCCESSFULLY TESTED, & PUT **ONLINE**
- HARVESTS FROM 5 DATABASES, MANY MORE TO BE ADDED SOON

data harvesting



- PROOF OF PRINCIPLE TOOL CREATED, SUCCESSFULLY TESTED, & PUT **ONLINE**
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18Ne_kaeri.html

file:///Users/Shared/15_INFRASTRUCTURE/18Ne_2010_04_24_01_44_01/18Ne_kaeri.html

Stellar Explosion Explorer nucastrodata.org NASA_ADS Yahoo! ORNL nuclearmasses.org bigbangonline.org WebPort

10-Ne-18

[basic](#)

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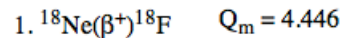
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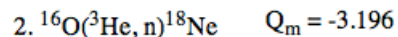
R.R.Kinsey, et al., *The NUDAT/PCNUDAT Program for Nuclear Data*, paper submitted to the 9 th International Symposium of Capture-Gamma-ray Spectroscopy and Re

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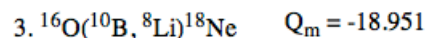
near term future ...



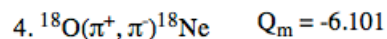
The half-life of ^{18}Ne is 1672 ± 8 msec: see [\(78AJ03\)](#) and [\(AD83A\)](#). The decay is primarily to $^{18}\text{F}^*(0, 1.04, 1.70)$. In addition there is an extremely weak branch $[(2.07 \pm 0.28) \times 10^{-3}\%]$ to $^{18}\text{F}^*(1.08)$ [$J^\pi = 0^-$; $T = 0$] [\(AD83A\)](#): see Table 18.21 (in [PDF](#) or [PS](#)) for the parameters of the decay. The parity mixing in the $^{18}\text{F}^*(1.04, 1.08) 0^+ - 0^-$ doublet has been studied by [\(AD83A\)](#). See also [\(HE82B\)](#). For the earlier work see, in particular, [\(AD81, HA81B\)](#). See also [\(AD83B, AD83C, AD83D, AD84D, AD85D, BR85K\)](#) and [\(HA84I, BR86Y, HA86FF, TO86G, KI87C; theor.\)](#).



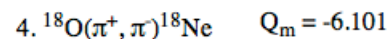
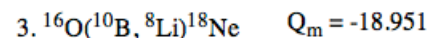
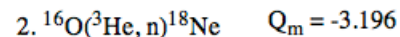
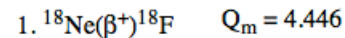
^{18}Ne evaluation
See Table 18.24 (in [PDF](#) or [PS](#)). See also [\(83AJ01\)](#).
(Ajzenberg-Seolve 1987)



At $E(^{10}\text{B}) = 100$ MeV the angular distribution to $^{18}\text{Ne}^*(3.38) [(d_{5/2})^2_{4+}$ state] which is preferentially populated has been studied. $^{18}\text{Ne}^*(1.89)$ is also observed. See [\(83AJ01\)](#). See also [\(OS83E; theor.\)](#).



TUNL



- EVALUATION TEMPLATES
 - CHOICES OF DIFFERENT TEMPLATE FORMATS
 - ENABLE TEMPLATE CUSTOMIZATION [GOOGLE APPS...]
 - **AUTOMATICALLY POPULATE TEMPLATE** WITH HARVESTED INFORMATION

near term future ...

ANL/TD/RP-90090

SOME GUIDELINES FOR THE EVALUATION OF NUCLEAR DATA

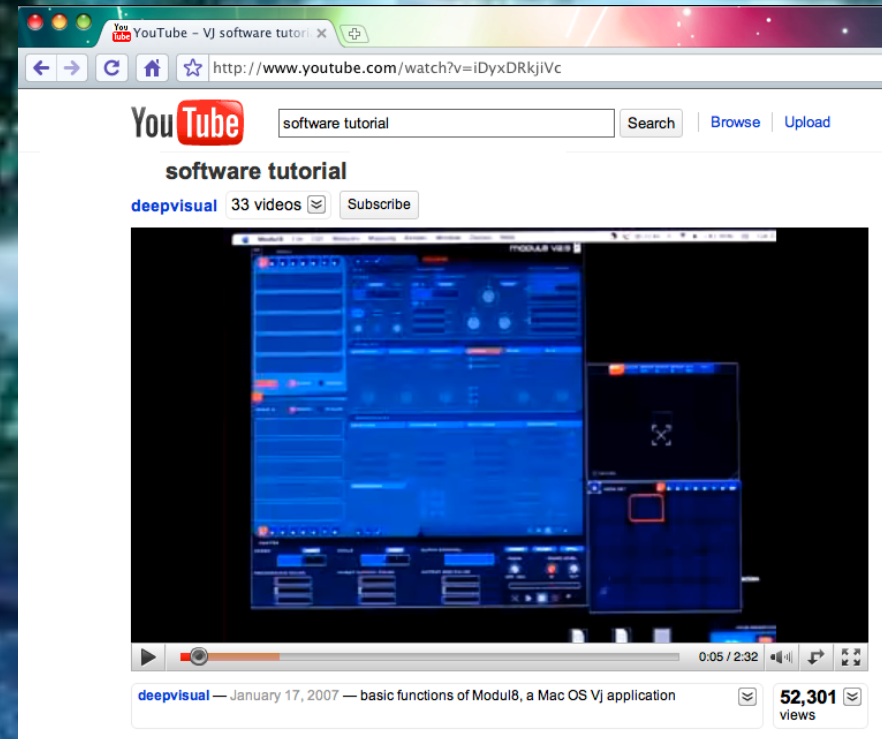
Donald L. Smith
Technology Development Division
Argonne National Laboratory
Argonne, Illinois 60439

March 20, 1996

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OSTI

Introduction

Modern data evaluation methodology draws upon basic principles from statistics. It differs from earlier *ad hoc* approaches which are completely subjective (e.g., eye guides to data) or are objective in a limited sense (e.g., combinations of reported data by a simple least-squares procedure without regard to correlations in the data errors or a careful scrutiny of the data included in the evaluation). In addition to utilizing more rigorous mathematical procedures, modern evaluation methodology involves taking great care to insure that the data which are being evaluated are equivalent to what has been assumed in the evaluation model and that the values are consistent with respect to the use of standards and other fundamental physical parameters. This short memorandum cannot substitute for more comprehensive treatments of the subject such as can be found in the listed references. The intent here is to provide an overview of the topic and to impress upon the reader that the evaluation of data of any sort is not a straightforward enterprise. Certainly evaluations cannot be carried out automatically with computer codes without considerable intervention on the part of the evaluator.

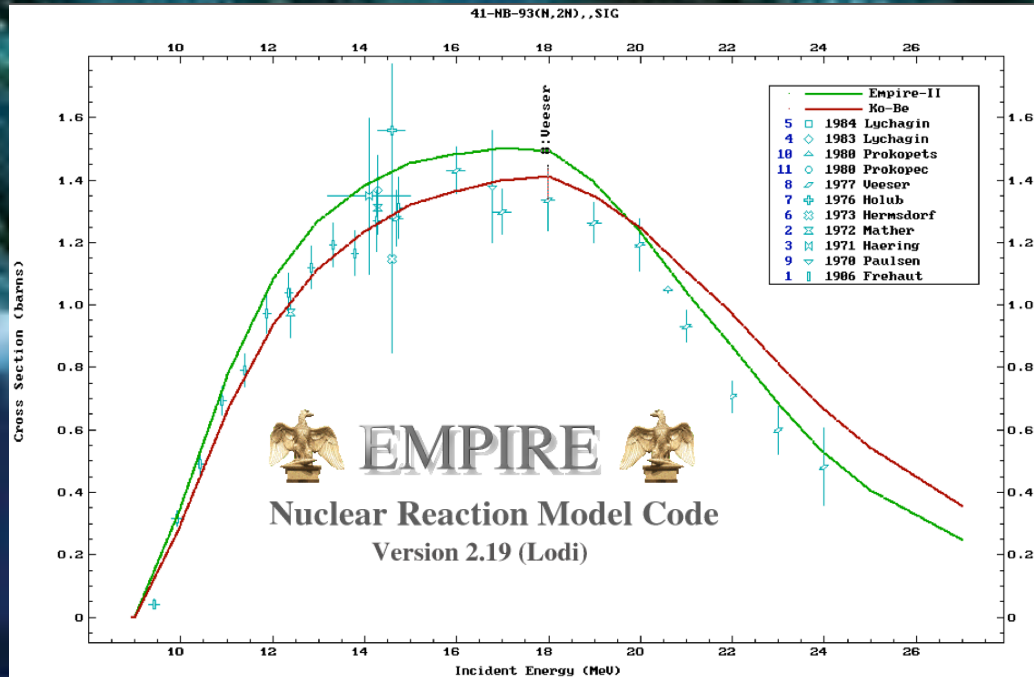


- EVALUATION GUIDES
 - INTERACTIVE ONLINE "HELP DESK"
 - HELP TRAIN NEXT GENERATION OF EVALUATORS
 - CAPTURE EXISTING EXPERTISE
 - UTILIZE SOCIAL MEDIA [YOUTUBE ...], PAPERS, TALKS...
 - CLOSELY COUPLE TO "CLOUD" EVALUATION TOOLS

cloud computing for nuclear data

michael smith ornl

longer term future ...



CDCC

$\neq 0$: Print out the $f(m'M' : mM; \theta)$ for each angle θ on file 57 for partition PEL, after the following information:

card A: (F10.4,3F8.4)

card B: (4F8.4)

card C: (4F8.4)

card D: (4A8)

card E: (4F8.1)

card F: (4I8)

card G: (4I4)

card H: (I4,2F8.4) NANG,THMIN,THINC

for each of the NBINS bins:

card I: (i2,2F4.1,3F8.4,2i4)

1,j,Emid,kmin,kmax,NK,KN,ISC

1,j: quantum numbers (s==Jv)

Emid: centre of bin with respect to continuum threshold

kmin,kmax,NK: Min,max and number of k values in bin integral

KN: original KN index for bin state

ISC: normalisation used for bin

for each IK=1,NK

Fresco

Coupled Reaction Channels Calculations

www.fresco.org.uk

ergy

valence

- HOPEFULLY MORE **ONLINE TOOLS** TO
 - SHARE / MANIPULATE / VISUALIZE DATA
 - AUTOMATE OF REPETITIVE TASKS
 - **RUN YOUR CUTTING EDGE NUCLEAR SCIENCE CODES**

cloud computing for nuclear data

michael smith ornl

exploring nuclear data in the clouds



- WOULD LIKE TO **EXPLORE** THE **TREMENDOUS POTENTIAL** OF **ONLINE SYSTEMS** FOR **NUCLEAR DATA**
- GREAT TO **SHARE IDEAS, CODES, MECHANISMS** TO **BRING NEW "NUCLEAR CLOUD" SYSTEMS ONLINE**

nuclear data cloud computing consortium



- SUGGEST FORMING A **WORKING GROUP** - NUCLEAR DATA CLOUD COMPUTING CONSORTIUM **NDC3**
- EMAIL "**CLOUD @ NUCASTRODATA.ORG**" TO JOIN

summary



- AN ONLINE APPROACH - "CLOUD COMPUTING" - PROVIDES MANY ADVANTAGES OVER TRADITIONAL DATA WORK
- THIS "WAVE OF THE FUTURE" ALREADY HAS STREAMLINED INCORPORATION OF LATEST DATA INTO ASTRO CODES
- COULD BE VERY USEFUL FOR YOUR WORK